The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED
The Engineers' Architects' and Builders' News

PUBLISHED WEEKLY

By the Technical Publishing Company, Atlas Building, 604 Mission Street, San Francisco Cal.
Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879.

Vol. XIX. No. 9 San Francisco, Cal., August 31, 1907. Yearly subscription $2.50 Single copies 10 cents Back numbers prior to current month 25 cents.

Electric Appliance Company
726-728-730 Mission Street
San Francisco

A Complete Line of Supplies

Coast Agents and Distributors of

ADAMS BAGNALL ARC LAMPS
PACKARD INCANDESCENT LAMPS AND TRANSFORMERS
SANGAMO WATT-METERS
"O. K." WEATHERPROOF WIRES AND CABLES
GEORGE CUTTER CO. SPECIALTIES
"GALVADUCT" AND "LORICATED" CONDUIT AND FITTINGS

NEW ADDRESS
PACIFIC COAST DEPARTMENT
STANDARD UNDERGROUND CABLE CO.
Suite 511, 512, 513 and 514
SHREVE BUILDING, SAN FRANCISCO, CAL.
BARE AND INSULATED WIRES AND CABLES

OKONITE WIRE
The Standard for Rubber Insulation
Okonite Tape, Manson Tape,
Candee Weather-proof Wire,
Candee (Patented) Potheads.
THE OKONITE COMPANY, 253 BROADWAY, N. Y.

INDIANA RUBBER AND INSULATED WIRE CO.
MANUFACTURERS OF
PARANITE AND PEERLESS RUBBER COVERED WIRES AND CABLES
Underground, Aerial, Submarine and Inside Use
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES
All Wires are Tested at Factory JONESBORO, IND.
Electric Appliance Company
728 Mission St., San Francisco Pacific Coast Agents

San Francisco Los Angeles Oakland
HENSHAW, BULKLEY & CO.
LIDGERWOOD HOISTS AND CABLEWAYS
219-221 Spear St. San Francisco, Cal.

Bristol's Recorders
For Every Electric Light
Railway, Power and Gas Plant Compel
Safe and Efficient Operation
Send for Catalogue A. V.
The Bristol Co., Waterbury, Conn.
N. Y., 114 Liberty St. Chicago, 753 Monadnock Block

The National Conduit & Cable Co.
Manufacturers of
TROLLEY WIRE
BARE COPPER WIRE AND CABLES
WEATHER-PROOF WIRES AND CABLES
PAPER-INSULATED CABLES
FOR TELEPHONE, TELEGRAPH AND POWER
703 MONADNOCK BUILDING, SAN FRANCISCO
C. H. PENNOYER, PACIFIC COAST MANAGER

BROOKS-FOLLIS ELECTRIC CORP.
Electrical Supplies of all Kinds in Stock
214 FIRST STREET, Cor. Tehama SAN FRANCISCO
OAKLAND, 563 13th Street

Meese & Gottfried Company
19th and Harrison Sts., SAN FRANCISCO
Power Transmitting Machinery
Of all description. We have a larger stock of Shafting, Hangers, Boxes, Pulleys, etc., than ever.
Seattle San Francisco Los Angeles

VAN EMON ELEVATOR CO.
MANUFACTURERS OF .... HIGH-GRADE ELEVATORS
R. J. DAVIS, President
B. C. VAN EMON, Vice-President and Manager
H. B. RATHBONE, Secretary and Treasurer
NOT IN THE ELEVATOR TRUST
DIRECTORS
LOUIS F. MONTEAGLE W. P. PLUMMER
GEO. M. PINCKARD R. S. WUNKINS
OFFICE AND CONSTRUCTION DEPARTMENT
52 - 54 NATOMA STREET, SAN FRANCISCO
FACTORY AND FOUNDRY
WEST BERKELEY, CAL. (32,000 sq. ft.)

THE NEWEST AND LATEST IN

ANNUNCIATORS

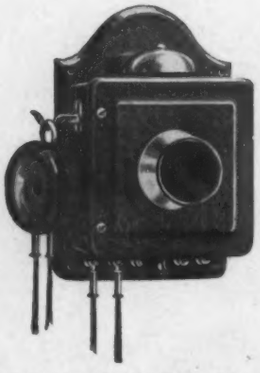
Self Contained

Gravity Drop

Write For Bulletin 15 A

"COUCH and SEELEY"

TELEPHONES and ANNUNCIATORS



WE ARE OUT FOR BUSINESS ON THE BASIS OF
HIGH QUALITY AND RIGHT PRICES
AND WE CARRY THE STOCK

Standard Electrical Works

Temporarily at
58-60 Natoma St. **San Francisco, Cal.**

THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

VOLUME XIX. SAN FRANCISCO, CAL., AUGUST 31, 1907 No. 9

THE VISALIA ELECTRIC RAILWAY

By Arthur H. Halloran.

The latest development in the great electrical field of the Pacific Coast is the use of a single-phase, 15-cycle, 3,300-volt, alternating electric current on the railway now nearing completion between Visalia and Lemon Cove, California. In addition to this noteworthy equipment it employs catenary suspension of an overhead trolley wire, from which current is taken by a pantagraph trolley with sliding contacts. As this is the first commercial application of the 15-cycle motor for railway purposes, its outcome will be watched with interest by the electrical engineering fraternity. On the main this description will follow the order in which work was conducted.

The construction involved the electrification of the existing steam road of the Southern Pacific Company between Visalia and Exeter, a distance of ten miles, and the construction of thirteen miles of road between Exeter and Kaweah terminal. The latter has been completed, and is now in operation as a steam road. The main pole line has been finished throughout, and the company is awaiting the completion of its main sub-station at Exeter. Power is to be obtained from the lines of the Mt. Whitney Power Company.

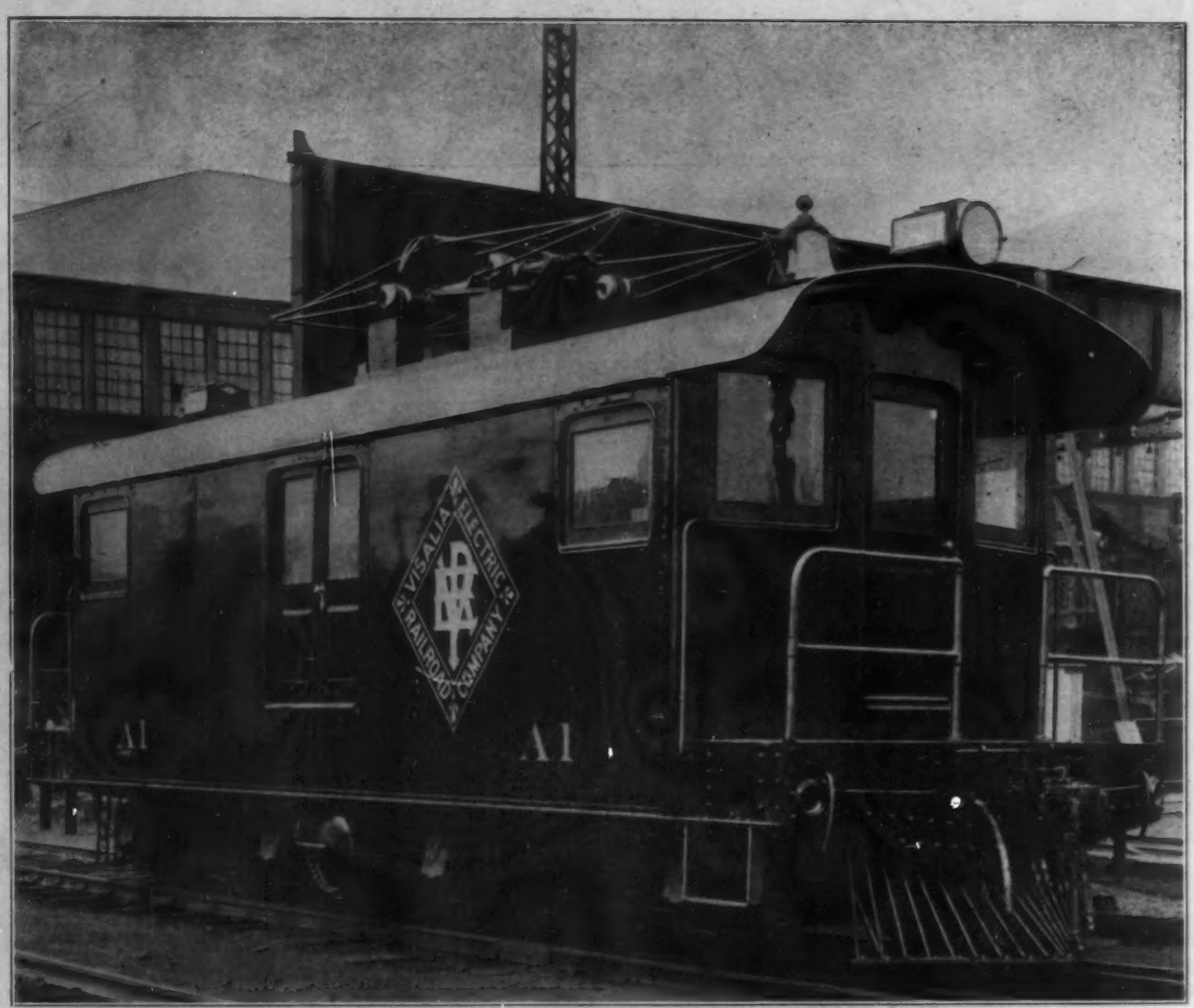


FIG. 1. 15-CYCLE, 3300 VOLT FREIGHT LOCOMOTIVE

Grading was started March 15, and completed in No-

vember, 1905. Track laying began June 15 and completed in December, 1905. Steam service has been maintained over the line since that time. From Visalia to Exeter

FIG. 2. VIEW OF CONSTRUCTION TRAIN AT EXETER

60-pound rails are used, and from Exeter to the terminal 50-pound rails. As most of the road was laid on the level floor of the San Joaquin Valley, very little cut and fill was necessary. Except at the switches and yards, single-track construction is used throughout.

The poles on the main line are of peeled redwood, 36 feet

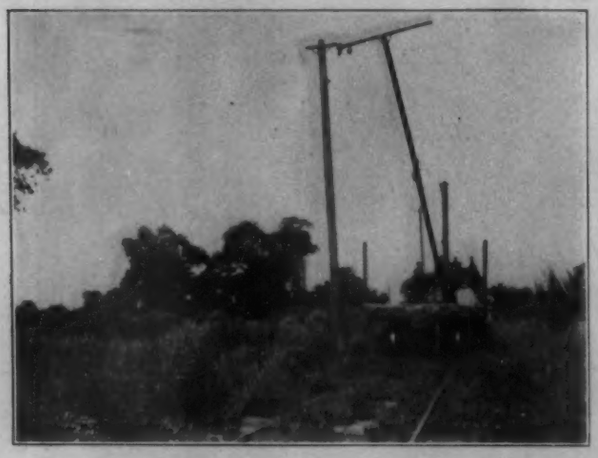


FIG. 4. STRINGING FEED WIRE

long, with 14-inch base and 7-inch top. They are imbedded in concrete to a depth of 6 feet. Except at switches and in the yards they are 120 feet apart. Incidentally it is of interest to note that forty poles were set in an eight-hour day. The concrete consisted of cement and sand, one to four. Ordinarily the poles were placed 8½ feet from the center of the track.

Cable guys, when used, consist of 7-16-inch diameter galvanized wire cable, fastened to a 6-8-inch diameter eye bolt, 10 inches between the center of the eye and the end. It is fastened to the pole with a 3-bolt cable clamp. The other end is fastened to a 6-foot, ½-inch diameter eyebolt, almost completely buried. Attached perpendicularly to the end of this is a 12x12x¼-inch plate with a hole in the center for ½-inch rod. Concrete was used to anchor these wherever the ground was soft.

In the Visalia yards the city regulations forbid the use of guys, as occupying too much space. Consequently steel poles are used to withstand the strain.

The overhead construction for the Visalia Electric Railroad is interesting as being the first complete catenary in-

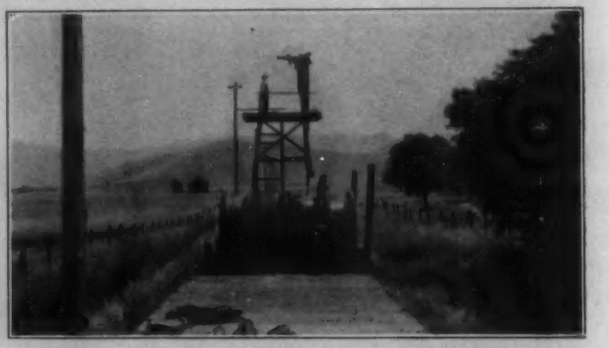


FIG. 5. STRINGING MESSENGER CABLE AND TROLLEY WIRE

stallation actually installed on the Pacific Coast, with the exception of the Vallejo, Benicia and Napa Valley Railway. The construction differs materially from the Vallejo road, however.

The majority of the overhead is of bracket construction, using a 10-foot 4x4 Oregon pine cross-arm, attached to the pole with a malleable iron bracket shoe. The bracket construction covers both single track and double tracks at turnouts, but in yard work span construction is used in places covering three and four tracks. The spans on tangents are 120 feet, and decrease on curves from 100 feet on a 6-degree curve to 60 feet on an 18-degree curve.

The messenger wire of 7-16-inch cable is mounted on the top side of the wooden cross-arm, and rests on a Victor No. 5A cable insulator and a steel bolt pin. At the point of support the 000 trolley wire is 17 inches from the messenger

wire, and the hangers supporting the trolley wire are spaced 10 feet apart.

The detail of the hanger is of some importance. The rod connecting the mechanical ear with the messenger clip is threaded through the clip and bears against the messenger wire so that when tightened up there is a three-point support.

At curves both the trolley and messenger are pulled off steadied in a transverse direction by means of two No. 601 Victor strain insulators mounted on the bottom of the cross-arm.

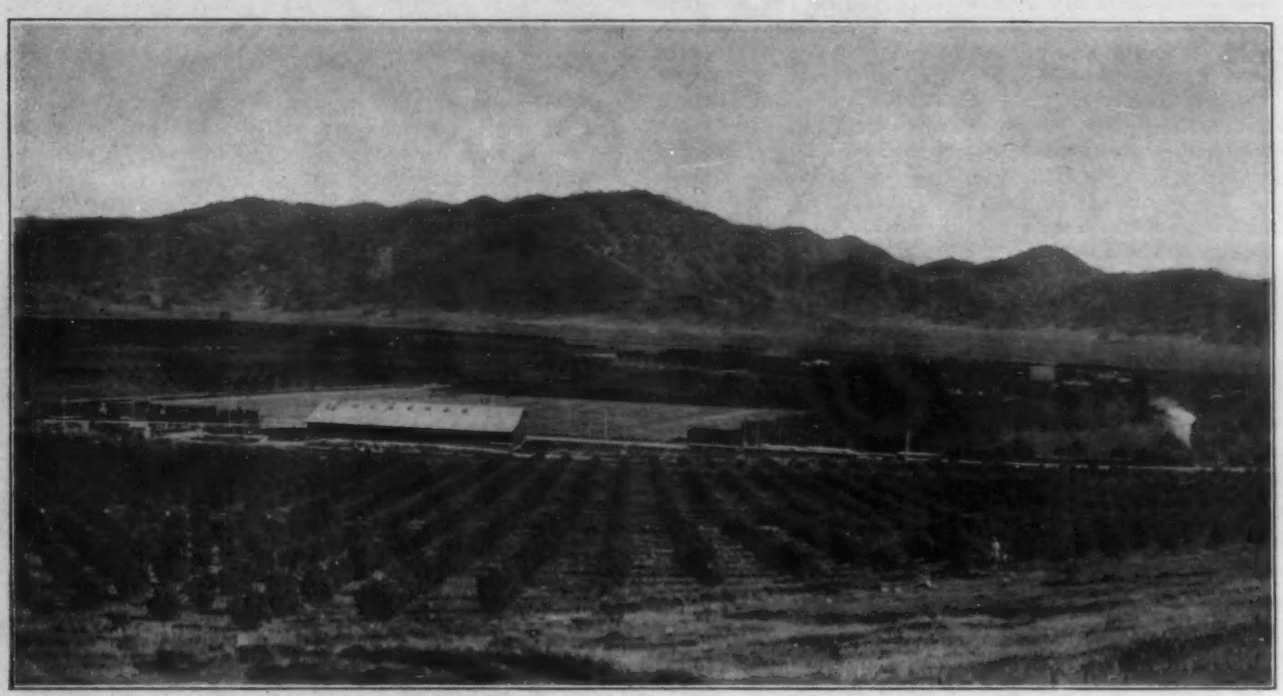


FIG. 3. WITH YOUNG ORANGE GROVE IN FOREGROUND

This type of construction lends itself readily to special conditions met with in turn-outs and yard work. The guying of span construction as worked out on the Visalia Electric Railway involves modifications of the above described material, but merely as to position. Strain insulators and

FIG. 6. CONCRETE POLE SETTING IN CREEK BED, SHOWING SINGLE SPA CONSTRUCTION

to a porcelain strain insulator supported on the pole by 5/8x15½ eyebolts. This strain insulator is the Victor No. 601, two-piece insulator. The bolt running through this insulator is grouted into position after erection, so as to distribute the strain of the trolley construction.

Every 1,000 to 1,200 feet the catenary construction is

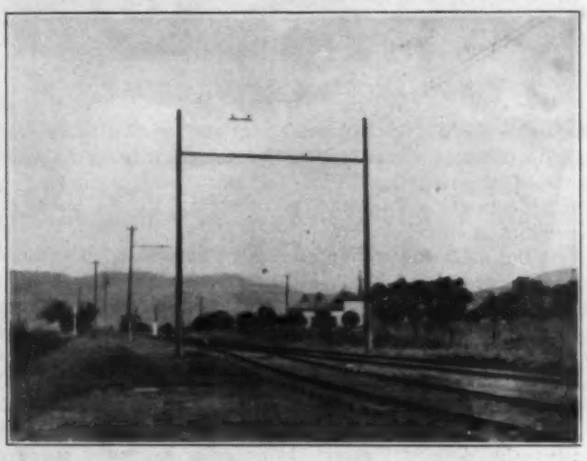


FIG. 7. LONG BRACKET AND TWO POLES

Crosby clips are used for the pull-offs, and are ample for insulation under the highest voltage practicable for a single-phase motive power, and at the same time have ample mechanical strength for the entire weight to be supported. A test of a span covering four tracks shows that a tension of 2,400 pounds was developed in the span wire.

The advantage of the type of strain insulator used lies in the fact that it has ample creepage surface for the high voltage employed, and at the same time puts the porcelain at all times in compression. Section insulators are installed at suitable points. The section insulator consists of an extra long Ohio Brass Co. "Miami" insulator supported on three strain insulators at the cross-arm.

The original bonds installed on this road were what is

GAL 2—Aug 24—DREW—1833 Electrical Journa known as the foot bond, consisting of flat laminated copper strips connected to beveled terminals at the base of each rail length. These bonds were afterwards reinforced by 34-inch flexible cable bonds of No. 0 B. & S. gauge capacity, which extended around the angle bars. The bonds used were the Ohio Brass Company's all wire type.

The catenary construction described above was designed and erected by Mr. James H. Crosett, superintendent of the Visalia Electric Railroad, and supplied for Pierson, Roeding & Company, by the Ohio Brass Company, of Mansfield, Ohio.

The accompanying illustrations exemplify some interesting variations from the standard construction. Fig. 6 shows the concrete pole setting in the bed of a creek, too wide to be spanned without intermediate support. It also shows the single bracket construction on the main line. In the yards and at turn-outs the messenger and trolley were suspended either by catenary span, double bracket or long bracket and two poles, depending on conditions. Fig. 7 illustrates a case where the space between the tracks at a turn-out was too narrow for the single pole and double bracket. Consequently two poles and a long bracket were used. As shown in Fig. 8, the double bracket on single pole was placed wherever

FIG. 8. DOUBLE BRACKET ON SINGLE POLE

practicable. Fig. 7 also shows the feeder wire suspension in order to obviate a short turn in the transition from the single to the double bracket. Fig. 9 illustrates a catenary span over four tracks. The steel poles in the Visalia yards are to support 22-foot brackets.

At the main sub-station at Exeter, current is to be taken from the lines of the Mt. Whitney Power Company at 35,000 volts, three-phase. At present this company is transmitting at 17,000 volts from its two plants on the Kaweah River. But arrangements have been made to raise this to 35,000. Plans have also been made for another plant on the Tule River.

The main sub-station is to be a substantial reinforced concrete building at Exeter. It occupies a ground space of 56x83 feet. The equipment consists essentially of three similar units, each consisting of step-down transformers, motor generator with exciter, and step-up transformers, together with complete switchboard facilities.

There are three banks of three 150-kilowatt oil insulated, water-cooled high tension Westinghouse lowering transformers, converting from 35,000 volts primary to 2,200 volts secondary, 7,200 A. P. M.

Thence the current at 2,200 volts, 3-phase, is conducted to the three two-bearing motor generator sets, each consisting of one 540 horsepower synchronous Westinghouse motor wound for 2,200 volts, 3-phase, 7,200 A. P. M., with induction starting motor on shaft extended, mounted on common shaft and bed-plate and direct connected to a 375-kilowatt revolving field alternating, single-phase Westinghouse generator wound for 11,000 volts, 15-cycle, speed 514 revolutions per minute. The synchronous motor is excited by an independent direct-current compound wound generator, direct connected to and mounted on the same base with a 3-phase induction motor. This set is designed to be of sufficient capacity to excite the synchronous motor at 25 per cent overload. The exciting dynamo is a 22-kilowatt, 122-volt, 850-revolution per minute, direct-current, compound wound Westinghouse generator. The synchronous motor is brought up to speed by a 35-horsepower, 3-phase, 200-volt, 60-cycle, type "C. C. L.," Westinghouse induction motor, complete with field rheostat for the direct-current generator and auto-starter for the induction motor. The single-phase generators, by means of a tirrill regulator, will maintain full load output with normal voltage at 40 per cent power factor.

The main switchboard consists of six panels of blue Vermont marble, including 2 synchronous motor control panels, 1 motor generator exciter control panel, 2 generator panels, and 1 exciter panel. All bus-bars and connections are placed below the board in a concrete sub-way. The wires run through underground conduits to the different machines.

The 11,000-volt single-phase current is conducted to

FIG. 9. FOUR TRACK CONSTRUCTION

three transformer sub-stations, one being placed in the main sub-station and the other two each 8 miles distant from the main sub-station toward each terminal. Each is equipped with two 300-kilowatt lowering transformers from 11,000 to 3,300 volts, at which voltage it is fed into the trolley line. A pantagraph trolley with sliding contact takes off the current to the car transformers.

Single-phase alternating current is carried into the car or locomotive and is stepped down through a variable voltage lowering transformer, by means of which the voltage supplied to the motor can be varied up and down over any desired range. The type of motor used is one in which the speed varies directly as the voltage applied. Speed control is thus obtained without waste of energy other than in the motor itself.

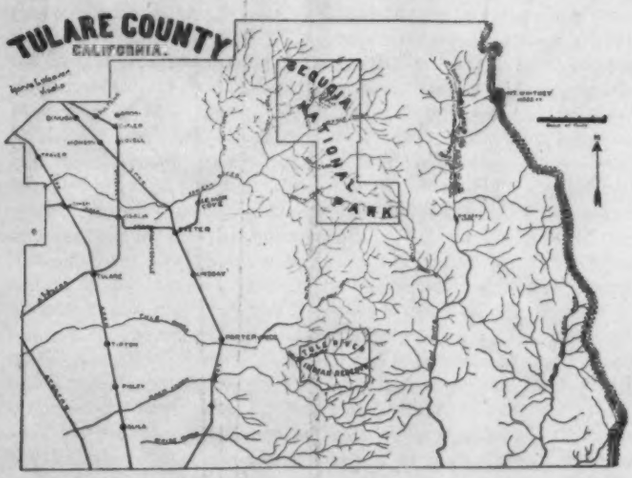
Rolling Stock.

Besides the electric locomotive illustrated in Figure 1, the rolling stock comprises six handsome semi-convertible interurban cars, measuring 46 feet 8 inches over vestibules. This equipment is divided into three types of car. There are two combination passenger, smoker and baggage motor cars, two combination passenger and smoking motor cars, and two passenger trailer cars. Each car is equipped with four quadruple, 75-horsepower, single-phase motors, together with automatic air brakes and step-down transformers provided with variable voltage connections. The locomotive used for freight hauling is similarly equipped with four 125-horsepower motors. All the car bodies are finished in mahogany and neatly decorated with inlaid or marguetry

border lines. The ceilings are to be of the full Empire type, tinted light green and ornamented with gold stripe. The ventilator glass is to be half oval fancy opalescent. Seats applying to all cars of spring covered with rattan, high back, with head roll and adjustable foot rest. Manila matting will be provided for the floors of passenger and smoking compartments. The window shades are of silk pantasote. Individual bronze basket racks are furnished along each side of the cars.

On account of these cars being operated in trains, the usual steam coach automatic M. C. B. coupler with the spring buffer will be furnished. Also a pilot of the steam coach practice will be provided at each end of the car. There will also be arranged at one end of each car a saloon lined with white enamel, steam coach practice.

Because of the large amount of machinery and electrical equipment that has to be suspended from the under-framing of the car, an exceptionally strong design of bottom framing has been provided, consisting of "I" beams, intermediate



and center sills, with combination plate and angle iron side sills. The "I" beams and plates are filled in with long leaf yellow pine. The flooring is made double with 2½-inch space between the upper and lower floor and filled with mineral wool to deaden the noise.

At the right-hand side of each vestibule there will be provided a motorman's compartment. The door will be hinged to swing inward and when closed against vestibule post will show any control apparatus and allow a clear passage from car to car.

The cars are now under construction at the works of the American Car Company, St. Louis, Mo., which order was placed through Pierson, Roeding & Company, Monadnock Building, San Francisco, Cal., the Pacific Coast selling agents of the J. G. Brill Company and their constituent plants. All electrical and mechanical equipment is to be furnished by the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa.

The car barn is to be built at Exeter opposite the substation. It will be 100x200 feet, with a capacity of twelve cars, there being three tracks and two pits. Complete machine shops are to be operated in connection with the barns.

As originally planned, this road was to employ twenty-five cycles. Subsequently, in light of recent investigations, it was modified to a 15-cycle system. According to N. W. Storer, include "an increase of from thirty to forty per cent in the output of a motor of given size and a consequent reduction in the total number of motors required to operate a railway and in the cost of equipment, better performance of the 15-cycle motors, including higher efficiency, higher power factor and better commutation, less dead weight to be carried on cars and locomotives and lower line losses."

Standard gauge freight cars from the Southern Pacific and Santa Fe tracks will handle the large tonnage of citrus fruit annually shipped from the district tapped by this electric road. Oranges and lemons ripen here three weeks later than they do in the southern part of California. A large acreage has been laid out in grapes and most of the deciduous fruits do well wherever the soil can be irrigated.

Irrigation has been greatly facilitated by the introduction of cheap electric power. Some pumping plants are located on the banks of the Kaweah River, but most of the smaller pumps take the water directly from wells. Water has transformed this region from an arid expanse of sun-baked plains used but part of the year for grazing purposes, to a garden spot, now one of the most productive in America.

A few hours' stage ride from Lemon Cove takes the tourist into the midst of the High Sierras, with their highest peaks perpetually capped with eternal snows, giving a never-failing source of water throughout the year. Canyons thousands of feet deep have been cut through these mountains by tumbling torrents tortuously thundering their tumultuous travail through towering trees toward the tumbling seas. Here are the finest of the giant redwoods preserved from the lumberman's devastating ax by government restrictions. The trail continues to the summit of Mt. Whitney, the highest mountain in the United States, exclusive of those in Alaska. Indeed, the ordinary stock of superlatives is exhausted in describing the beauties of the southern Sierra Nevada Mountains. These will ultimately form the attraction to the tourist, and it is this travel that the electric road is counting on for much of its revenue.

Too much credit can not be given to Engineer James H. Crossett for the masterful way in which he has solved numerous problems of construction. His original methods in pole-raising and wire-stringing have saved much time. It is through his courtesy that we are indebted for much of the detail in this article.

ELECTRIC INSTALLATIONS IN SPAIN.

L'Industrie Electrique gives some interesting statistics relating to electrical installations in Spain. From official compilations to the end of 1904, it gathers that there were 1151 such installations, having a total power of about 100,000 kilowatts. The distribution of energy among different classes of users is seen in the following table:

	Public		Private	
		Power in kw.		Power in kw.
	No.		No.	
Motive Power	3	1,847	8	543
Motors and lighting.....	114	38,144	34	3,329
Lighting	670	45,577	...	....
Traction	8	6,347	...	....
Hotel installations	...	.....	11	251
Industrial installations	...	.....	302	3,744
Furnaces (electric)	...	.....	1	....
Totals	795	91,915	356	7,957

Steam is used for generating current on 75 of these installations, hydraulic power is used in 148 cases, gas engines in 25 cases, and on 42 installations steam and gas are used.

MECHANICAL TESTS OF PUMPS AND PUMPING PLANTS IN CALIFORNIA.*

By J. N. Le Conte and C. E. Tait.

During the summer of 1905, the Irrigation and Drainage Investigations continued the work begun during the previous year of testing pumps and pumping plants with the object of determining the actual cost of pumping water for irrigation under various conditions and by various methods, and also the directions in which improvements may be

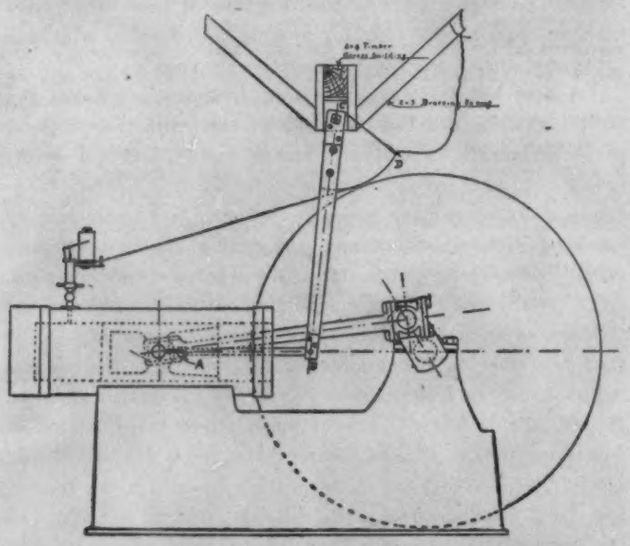


FIG. 1. APPARATUS FOR TESTING GASOLINE ENGINES

sought for the purpose of decreasing the cost of pumping. The field work was conducted in the regions immediately surrounding Pomona and Riverside, in Southern California, and on the lower Sacramento River in Central California, among the reclamation districts.

The field work included two classes of tests. The first class consisted of complete tests, or those as nearly complete as the conditions of operation would permit. These required measurement of the power developed, either by means of the engine indicator or by indicating wattmeters, a continuous record of the lift, a measurement of the water by means of a weir, and a measurement of the fuel consumed. The second class consisted of partial tests, where no measurement of power was attempted, but merely a measurement of fuel (or electrical energy), water, and lift, for the purpose of determining the cost of pumping water. Throughout the season's work particular efforts were made to obtain the cost of installation and operation, in order to estimate the fixed charges and labor items which constitute so large a portion of running expenses.

The field work has been sufficient for the working out of a fairly convenient and satisfactory system of testing, and for the benefit of others who wish to make similar tests the methods used are given below.

Measurement of Fuel.

Gasoline for small engines is usually contained in cylindrical tanks at some distance from the pump house and piped to the engine. In such cases the position of the surface of the oil is taken with a small hook gauge, consisting of a sharpened piece of wire bent into the form of a hook and fastened to the end of a stick. The surface is noted at the beginning and end of the test by marks made on the stick with the blade of a penknife. The distance between these marks should be measured with a fine scale, and from this and the dimensions of the tank the volume of the gasoline is computed. It is of particular importance to make this measurement every hour in order that an accidental change in the running conditions, or an error shall not destroy an otherwise good test. When the tank is irregular in cross section, or when, though cylindrical, the axis is horizontal, the surface is noted at the beginning of the test as before, and at the end of the test the engine is shut down at once. Weighed quantities of gasoline are then poured into the tank until the level returns to the original mark, and the total weight consumed is known. A tested spring balance weighing up to twenty pounds is convenient

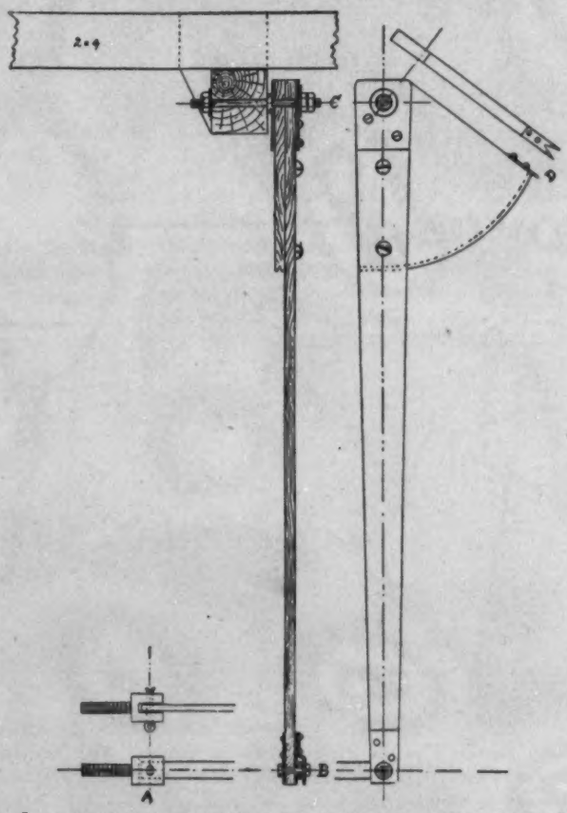


FIG. 2. DETAIL OF APPARATUS FOR TESTING GASOLINE ENGINES

for this work. Crude oil used for steam boilers can be measured in the same way unless the area of the containing tank is too great to make an appreciable fall in the surface during the test. In this case (and in fact in all cases where possible) the oil should be weighed out. The pipe leading from the tank to the boiler should be cut, and the burners made to draw their supply from a barrel on the floor of the station. This, in turn, is replenished from time to time from a second barrel on a platform scale. This second barrel is filled either directly by gravity from the oil tank or by a hand pump from the same source of supply. In this way weighed quantities of oil can be poured into the first barrel, but care should be taken that the level of the oil in this latter is the same at the beginning and end of the test. In all cases the density of the gasoline, or oil, should be taken on a hydrometer so that weight can be reduced to gallons.

Measurement of Power.

Measurement of the indicated horsepower of a gas engine is the most difficult of all measurements to make in the field. It was found in our experience that all ready-made reducing motions, or reducing wheels, are unsatisfactory when used on the ordinary gas engine, and that the pendulum-reducing motion gives the best results. The following is a description of the device used: In nearly all gas engines there will be found a set screw at A (Fig. 1) which serves to hold the wrist pin in the piston and prevent it

*U. S. Dept. Agr., Office of Experiment Stations, Bul. 181.

from turning. In many engines there are two of these. This set screw is removed and another inserted which has a slotted head, as at A (Fig. 2). Several of these should be kept on hand to correspond with the standard sizes of set screws—that is, one-half inch, five-eighths inch, three-fourths inch, etc. This slotted set screw is set into the piston with the slot vertical. A number of flat links are then made with lengths varying from fourteen to twenty-eight inches and about three-sixteenths by three-fourths inch in cross section. The longer ones may be made heavier, say one-fourth by one inch, but the ends must be brought down to three-sixteenths inch in thickness to fit the slots in the set screws. The link is chosen which corresponds to the stroke of the particular engine under test, and one end is fastened into the slotted set screw by a three-sixteenths-inch split pin. A lever or pendulum is then constructed of light strong wood, as shown in Figure 2. The lower end is protected with one-eighth inch iron plate, as shown, so as to receive the other end B of the link, and this latter is secured thereto with a small bolt. At the upper end of the pendulum there is fastened by a couple of wood screws a sector whose radius corresponds to the stroke of the engine under test, and both sides are protected with one-eighth inch iron plate. The whole is hung from an iron pin containing a shoulder, as shown at C (Fig. 2). A couple of jam nuts prevent the pendulum from slipping off the pin, which is passed through a wooden block nailed to a timber which spans the pump house above the engine at right angles to the line of connection. This timber should be braced from the roof or sides of the building. The pendulum is so adjusted that it hangs vertical with the piston at mid stroke and with the link AB horizontal. A groove is cut on the perimeter of the circular sector, and a piece of metal with a V-shaped notch at D (Fig. 2) engages a knot on the indicator card, so that the indicator can be hooked up or unhooked without difficulty. Care should be taken that the whole apparatus is well constructed, so that no breakdown may occur when running at high speed. Where engines are "short connected" no great error is caused by allowing the end B of the pendulum to override the crank at its extreme outward throw. Of course, only such engines can be indicated as have the necessary opening for the indicator plug or some opening into the explosion chamber to which the indicator can be attached by short piping. Nearly all steam engines are already piped for the indicator and with them the ordinary reducing wheel may be used.

In taking cards on a gasoline engine it has been our custom to take a number on the same sheet, say six to ten. Successive cycles in such engines are seldom identical, so that a series of cycles is necessary to get an average indicated horsepower. Where the cycles are very nearly alike, so that the lines run close together and blur into one another, the planimeter can be run by eye through the mean position of such lines. Where the cycles differ widely the planimeter can be run around each separately and the set averaged in this way. A single cycle taken with the indicator on a gasoline engine is of little use in computing horsepower. The indicated horsepower is computed by the ordinary formula:

$$\text{Indicated horsepower} = \frac{PLAN}{33{,}000},$$

in which, P = mean effective pressure in pounds per square inch.

L = length of stroke in feet.

A = effective area of piston in square inches.

N = number of effective strokes per minute.

For measuring electric power the indicating wattmeter is used. Electrical horsepower is computed by dividing the number of kilowatts by 0.746.

Measurement of Lift.

Few pumps are so arranged that it is convenient to attach pressure and vacuum gauges and thus obtain the actual head worked against by the pump. In deep-well pumps, air lifts, and centrifugals running under water it is practically impossible to use gauges, and so few plants were found where gauges could be properly applied that the attempt to get the working head by this method was abandoned and the measured or leveled head was used instead. This is obtained by measuring with a tape the vertical distance from the surface of the water in the sump or in the well casing to the center of the final discharge. When the pump runs under water in an open pit or when the suction draws from a ditch or stream, this is most easily done by attaching a float to the end of the tape and lowering it until it touches the water. When the level of the water falls so as to be below the top of the casing of a bored well or in an air well, the measurement is more difficult. Where there is sufficient space between the well casing and the suction pipe, say an inch and a half, a small float may be lowered to the water level if the well is bored straight. A long rubber tube, open at both ends, is sometimes used for determining water levels in wells. By weighting one end the tube can be lowered into a very narrow space and the water level can be determined by blowing through the tube with a steady pressure. However, the crookedness of the well casing and the sleeves on the suction pipe may prevent the lowering of the tube. A dry steel tape may be lowered into the well and withdrawn, the wet portion indicating the water level. The difficulty here is that the wet sides of the well casing and suction pipe may give false indications, and it entirely fails if water is draining from the pit into the well. With all the different methods tried, several instances were found where it was impossible to measure with certainty the depth to water. Since the actual head pumped against is valuable information for the irrigator himself, the writer proposes the following arrangement, which, if installed when the plant is erected, would furnish an easy and certain method of determining the lift: When the pump or suction pipe is first lowered into the well, let a small pipe of, say, three-eighths or one-half inch in diameter be lowered with it. This can be secured to the sides of the suction pipe at intervals and should reach within a foot or so of its lower end. Its length must be carefully measured before lowering. The upper end should be connected to a receiver of about a cubic foot capacity and an accurate pressure gauge attached to this latter. Air can be forced into this receiver with a small bicycle pump, or if the engine be so arranged as to start by compressed air, this can be used to charge the receiver. The pressure gauge will then rise till the air bubbles out of the end of the small pipe, but no higher. The supply of compressed air being discontinued, the reading of the gauge, multiplied by 2.3, will give the length of the small pipe, submerged, which, when subtracted from the total length of the small pipe, will give the depth to water. It is evident that a paper dial, graduated so as to read the actual lift on the pump directly, could be substituted for the regular one on the gauge.

Measurement of Water.

The discharge was measured in nearly every instance by means of a weir. Many plants in Southern California have weirs installed either at the pump house or somewhere on the pipe line. These usually consist of a concrete box, which receives the water from the pump at one end and delivers the water over a weir set in a concrete partition into a second compartment, from which the pipe line distributes the water to the orchard. When the pipe line is very long or of too small diameter or has little slope, the weir is drowned and rendered useless. The free contractions of most weirs made in this way are interfered with by the concrete of the partition coming too close to the crest and sides of the weir. The box is nearly always too short to permit the use of baffle plates to still the violent commotion produced by the pump discharge. For purposes

of testing, an ordinary weir board set in an open ditch is vastly better than the majority of permanent weirs found in the ditches tested.

All the results of these measurements have been computed by means of the Francis weir formula ($Q = 3.33 (b-.2h)h\ 3/2$), that being the basis of most of the weir tables in use by the irrigators and also the one employed by this office in compiling its weir tables. The writer is certain, however, from his own experiments, as well as from the work of others, that this formula gives results too small for low heads and narrow crests. Francis himself did not intend it to be used for heads under six inches and for breadths under three feet, yet it has been extended to cover all cases of heads and breadths without regard to the truth. A closer approximation to the discharge would probably be reached by using the weir coefficients of Hamilton Smith, Jr. The same criticism applies to the Cipolletti weir formula as generally used.

The head on the weir has been measured by an ordinary rule held on the head of a nail, which was previously leveled with the crest of the weir by means of a straight-edge and machinist's level. The readings could not be made closer than the nearest one-sixteenth inch. It was on account of this rather rough method of measurement that no closer approximation than the Francis formula was made.

The useful water horsepower of a pump is computed by the following formula: Useful water horsepower $= \frac{Q\,w\,h}{550}$,

in which

Q = volume of water pumped in cubic feet per second.
w = weight of 1 cubic foot of water = 62.3 pounds.
h = lift or head through which the water is actually raised, in feet.

Measurement of Feed Water.

Feed water was measured wherever possible, by taking the fall in the level of the feed tank, and in one instance with a Worthington piston meter, already installed in the feed line. For a careful test the water should be weighed out on a platform scale exactly as described for oil measurements. As the amount of feed water handled, however, is more than ten times that of the oil, the apparatus required must be many times larger and more elaborate. Such a method is scarcely applicable to tests of the character of those herein described, especially as the feed water is the least important factor from our point of view.

The tables below summarize the results of the tests. For the gasoline-engine and steam-engine driven plants the plant efficiency is the ratio of the useful water horsepower to the indicated horsepower. For the electrically driven plants, the plant efficiency is the ratio of the useful horsepower to the electrical horsepower.

The final relation of fuel consumption to water lifted is expressed as the number of gallons of oil or the number of kilowatt hours required per useful water horsepower hour. In reducing this to actual cost the price paid by the pump owner per gallon of gasoline per barrel of crude oil or per kilowatt hour has been used. The number of hours which each plant runs per year, the cost of the plant, and the cost of attendance and repairs have each been obtained as accurately as possible. From the nature of the case these items are somewhat uncertain. The rate of depreciation of pumping plants varies through an enormous range, being determined largely by the skill and care of the attendant. Many

Summary of complete tests on gasoline pumping plants

No. of test.	Discharge. Per second.	Discharge. Per minute.	Lift.	Useful water horsepower.	Indicated horsepower.	Plant efficiency.	Duration of test.		Gasoline consumed. Total during test.	Per hour.	Per indicated horsepower hour.	Per useful water horsepower hour.	Number of hours plant runs per year.	Total gasoline used per year.	Cost of gasoline per gallon.
	Cu. ft.	*Galls.*	*Feet*			*P. ct.*	*h.*	*m.*	*Galls.*	*Galls.*	*Galls.*	*Galls.*		*Galls.*	
1	0.328	147	44.4	1.65	5.64	29	1	7	0.97	0.87	0.154	0.527	300	261	$0.05½
2	.671	301	61.9	4.70	16.3	29	3	10	7.29	2.30	.141	.489	2,600	6,000	.05¼
3	5.94	2,666	11.3	7.60	38.0	20	3	0	16.88	5.62	.148	.741	4,320	24,300	.05
4	.829	372	96.5	9.05	26.5	34	3	8½	9.28	2.95	.111	.326	496	1,460	.06
5	1.36	611	67.9	10.4	35.2	30	3	0	11.42	3.81	.108	.366	470	1,800	.05½
6	1.51	678	62.0	10.6	29.3	36	1	0	2.47	2.47	.084	.233	850	2,100	.06¾
7	1.09	489	93.5	11.4	26.7	43	4	0	11.04	2.76	.103	.242	1,800	4,970	.05¼
8	1.33	597	90.3	13.6	40.8	33	3	30	14.86	4.25	.104	.312	1,000	4,250	.05
9	4.96	2,226	55.0	30.9	63.1	49	6	0	37.85	6.31	.100	.204	1,920	12,100	.05½
10	.241	108	203.5	5.56	16.7	33	2	40	4.36	1.63	.098	.293	720	1,170	.05½
11	.354	159	180.3	7.23	13.9	52	4	41	7.70	1.64	.118	.227	360	590	.06

No. of test.	Total cost of plant.	Fixed charge per year at 20 per cent on total cost of plant.	Cost of gasoline per year.	Cost of attendance and repairs per year.	Total cost per year.	Cost per useful water horsepower hour. Fixed charges.	Gasoline.	Attendance and repair.	Total.	Cost per foot acre-foot. Gasoline.	Total.	Cost per acre foot of water pumped. Gasoline.	Total.
1	$3,056	$611	$ 14	$ 50	$ 675	$1.234	$0.029	$0.101	$1.364	$0.040	$1.875	$1.78	$83.03
2	1,400	280	330	0	610	.023	.027	.000	.050	.037	.069	2.29	4.27
3	3,400	680	1,210	300	2,190	.021	.037	.009	.067	.051	.092	.58	1.05
4	3,200	640	88	83	811	.143	.020	.018	.181	.028	.249	2.70	24.00
5	3,343	668	99	0	767	.137	.020	.000	.157	.028	.216	1.90	14.70
6	2,500	500	142	0	642	.055	.016	.000	.071	.022	.098	1.36	6.08
7	3,200	640	261	450	1,351	.031	.013	.022	.066	.018	.090	1.68	8.41
8	3,000	600	212	125	937	.044	.016	.009	.069	.022	.095	1.99	8.58
9	3,500	700	660	300	1,660	.012	.011	.005	.028	.015	.038	.82	2.09
10	3,000	600	65	0	665	.150	.016	.000	.166	.022	.228	4.48	46.40
11	1,555	311	35	75	421	.119	.014	.029	.162	.019	.223	3.43	40.20

plants are not insured at all. Averaging all conditions found, the following appears to be a fair estimate of the rates suitable for use in computing the fixed charges of the various types of plants:

Basis for Computing Fixed Charges.—Gasoline Engine Plants.

	Per cent.
Depreciation	12 to 15
Interest	6
Taxes and insurance	1
Average total	20

Motor-driven Plants.

Depreciation	7 to 9
Interest	6
Taxes and insurance	1
Average total	15

Steam Plants of Ordinary Type.

Depreciation	9 to 11
Interest	6
Taxes and insurance	1
Average total	17
Highest quality steam plants—average	12

In the case of the larger steam plants that per cent has been chosen for each individual case which seemed suitable to the special conditions of the plant. These percentages are applied to the first cost of the entire pumping station, including the cost of wells. The latter, of course, varies greatly with the depth of the wells.

The item of labor is also a difficult one to estimate. Some plants employ an engineer during the whole year, and others only during the pumping season. Others have one man to look after several plants, and many plants have no attention whatever.

Gasoline Plants.

The following table summarizes the results of the test of pumping plants using gasoline engines:

Tests numbered 1 to 9 are of gasoline engines running centrifugal pumps. They are arranged in order of the amount of the useful water horsepower, beginning with the smallest. Tests 10 and 11 are of gasoline engines running deep-well pumps. For the centrifugal pumps the discharge varies between 0.328 cubic foot per second, or 147 gallons per minute, for No. 1, and 5.94 cubic feet per second, or 2,666 gallons per minute, for No. 3. The lift varies from 11.3 feet for No. 3 to 96.5 feet for No. 4. The pumps of Nos. 4, 7, and 8 are all compound centrifugals, with lifts exceeding 90 feet, while all the others are single-runner pumps. The useful water horsepower varies from 1.65 for No. 1 to 30.9 for 9. The indicated horsepower varies from 5.64 for No. 1 to 63.1 for No. 9. This covers a wide range and includes within its limits the majority of pumping plants in use for irrigation in California.

The plant efficiency varies irregularly. It depends somewhat upon the condition of the gasoline engine, but probably chiefly upon the arrangement and condition of the pump and piping. All turns and obstructions in the piping,

Summary of complete tests on electrically driven pumping plants

No. of test.	Discharge. Per second.	Discharge. Per minute.	Lift.	Useful water horsepower.	Electrical horsepower.	Plant efficiency.	Duration of test.	Kilowatts.	Kilowatts per useful horsepower.	Number of hours plant runs per year.	Total kilowatt hours per year.	Cost of electricity per kilowatt hour.
	Cu. ft.	*Galls.*	*Feet*			*Per ct.*	*h. m.*					
12	0.714	320	62.0	5.01	14.5	35	2 0	10.8	2.16	2,600	28,100	$0.02½
13	2.21	992	22.5	5.62	12.6	45	1 30	9.40	1.67	4,320	40,600	.02
14	1.26	566	60.3	8.57	22.0	39	2 30	16.48	1.91	1,440	23,600	.02½
15	2.97	1,333	28.1	9.45	55.2	17	2 0	41.2	4.36	2,880	118,700	.018
16	1.38	620	94.3	14.7	31.9	46	3 0	23.8	1.62	....	.....	.02½
17	1.10	494	122.4	15.3	31.6	48	4 0	23.6	1.54	558	13,200	.02½
18	1.82	817	188.9	39.0	71.2	55	3 0	53.1	1.36	3,000	160,000	.02½
19	.492	221	38.2	2.13	7.16	30	1 0	5.34	2.51	1,100	5,870	.02
20	.432	194	63.0	3.08	8.42	37	2 0	6.28	2.04	2,160	13,600	.02½
21	.750	337	63.0	5.36	13.1	41	2 15	9.76	1.82	2,160	21,100	.02½
22	.691	310	75.0	5.87	11.1	53	2 15	8.29	1.41	1,440	11,900	.018
23	.742	333	88.8	7.46	13.7	54	1 0	10.29	1.37	....	.....	.02
24	.679	305	98.1	7.55	15.4	49	45	11.50	1.52	1,400	16,100	.02

No. of test.	Total cost of plant.	Fixed charges per year at 15 per cent on total cost of plant.	Cost of electricity per year.	Cost of attendance and repairs per year.	Total cost per year.	Cost per useful water horsepower hour. Fixed charges.	Electricity.	Attendance and repairs.	Total.	Cost per foot-acre-foot. Electricity.	Total.	Cost per acre-foot of water pumped. Electricity.	Total.
12	$1,150	$173	$ 657	$ 0	$ 830	$0.013	$0.050	$0.00	$0.064	$0.069	$0.088	$4.28	$ 5.46
13	2,500	375	810	350	1,535	.015	.033	.015	.063	.045	.087	1.01	1.96
14	1,600	240	590	223	1,053	.019	.048	.018	.085	.066	.117	3.98	7.06
15	3,000	450	2,130	500	3,080	.017	.078	.018	.113	.107	.155	3.01	4.36
16	....	....	....	....	....	....	.038	....	....	.052	....	4.90	....
17	3,400	510	330	132	972	.060	.039	.015	.114	.054	.157	6.61	19.20
18	6,000	900	4,000	1,200	6,100	.008	.034	.010	.052	.047	.071	8.88	13.40
19	1,500	225	117	0	342	.096	.050	.0	.146	.069	.201	2.64	7.68
20	3,580	540	340	150	1,030	.081	.051	.023	.155	.070	.213	4.41	13.40
21	4,950	740	530	150	1,420	.064	.046	.013	.123	.063	.169	3.97	10.60
22	3,000	450	214	100	764	.053	.025	.012	.090	.034	.124	2.55	9.30
23	....	....	....	....	....	....	.027	....	....	.037	....	3.29	....
24	2,000	300	322	0	622	.029	.030	.0	.059	.041	.081	4.02	7.95

any variation in speed of the pump from the speed most suitable to the discharge and lift, any great length of discharge pipe, all tend to reduce seriously the plant efficiency. To secure the best results the size and speed of both pump and engine and all the connections and piping should be carefully planned for the special conditions under which the plant is to operate. No. 3 has an abnormally low efficiency. As explained in the account of the test, this seems to be largely due to the low head under which the plant is operating, since it is adapted to work on a much higher head. The efficiency of No. 5 is unduly low on account of air drawn into the suction pipe. Likewise the efficiency of No. 8 is lower than would be expected in a plant of its size, but the reason is not apparent from the data obtained. In general the results indicate that the plant efficiency should vary from about 30 per cent for the smaller plants to about 50 per cent for the largest plants. Any unusual low value means a continual loss to the owner of the plant during its operation, due either to its careless handling or to its faulty design and construction.

The amount of gasoline used per indicated horsepower hour varies rather regularly from 0.154 gallon for the smallest plant to 0.100 gallon for the largest. The amount of gasoline used per useful water horsepower hour depends upon both the plant efficiency and the amount consumed per indicated horsepower hour, and hence is quite variable. For No. 3 the amount of gasoline consumed per useful horsepower hour is unduly high on account of the low plant efficiency. Omitting this plant from consideration, we may conclude that the amount of gasoline required per useful horsepower hour varies from about 0.5 gallon for the smallest plant to 0.2 gallon for the largest plants.

The plant efficiency in deep-well pumps in general may probably be expected to surpass the efficiency of centrifugal pumps, although the two tests, Nos. 10 and 11 in this series, are scarcely sufficient to prove the general law. The efficiency and amount of gasoline consumed in these two tests compare very favorably with the results obtained from centrifugal pumps of much larger capacity, and this fact tends to compensate in some measure for some of the disadvantages attendant upon the use of deep-well pumps.

The price of gasoline has been remarkably low (7½ cents per gallon) in Southern California, because of the fierce competition of oil producers and refiners in that region.

In other pumping localities 10 to 12 cents a gallon is considered a low price for gasoline, and it is doubtful if the present low price will be long maintained in Southern

Summary of complete tests on steam-driven plants

No. of test.	Discharge. Per second.	Discharge. Per minute.	Lift.	Useful water horsepower.	Indicated horsepower.	Plant efficiency.	Duration of test.	Fuel oil consumed. Total during test.	Fuel oil consumed. Per hour.	Fuel oil consumed. Per indicated horsepower hour.	Fuel oil consumed. Per useful water horsepower hour.	Number of hours plant runs per year.	Total fuel oil consumed per year.	Cost of fuel oil per barrel.
	Cu. ft.	*Galls.*	*Feet*			*P. ct.*	*h. m.*	*Galls.*	*Galls.*	*Galls.*	*Galls.*		*Bbls.*	
25	.578	259	164.0	10.7	31.8	34	4 30	122.8	27.3	0.859	2.55	....	....	$0.75
26	1.37	615	94.3	14.7	31.7	46	3 0	63.9	21.3	.672	1.45	....	....	.75
27	1.71	768	213.4	41.3	107.8	38	5 30	185	33.6	.312	.814	4,320	3,460	.80
28	54.77	24,590	13.48	83.7	139	60	3 30	186.4	53.2	.383	6.36	....	....	.85
29	52.02	23,350	13.39	78.9	134	59	2 30	109.5	43.8	.327	.555	....	....	.85
30	103.7	46,550	13.59	159.6	.....	....	1 30	115.2	76.8	.....	.481	2,310	4,225	.85
31	95.4	42,820	9.85	106.4	239	45	3 30	187.5	53.6	.224	.504	....	4,000	.90
32	87.4	39,230	9.74	96.4	216	45	3 15	172.5	53.1	.246	.551	....		
33	3.90	1,750	247	109.2	117.0	93	.. ..	.....	....	.....	.....	....	....	...
34	3.27	1,468	247	91.4	100.6	91	.. ..	.....	....	.....	.....	....	....	...
35	....	.....	.....	200.6	217.6	92	6 0	229	38.2	.176	.190	5,000	4,600	1.00
36	1.34	602	50	7.59	43.9	17	4 12½	84	20.0	.456	2.64	5,800	2,700	.75
37	2.104	944	87.4	20.8	116.7	18	6 0	160	26.7	.229	1.28	a3,840	2,440	.75
38	4.62	2,074	42	22.0	113.7	16	6 51	84.8	27.0	.202	1.23	5,000	3,200	.75

a 1905

No. of test.	Total cost of plant.	Rate for computing fixed charges.	Fixed charges per year.	Cost of fuel oil per year.	Cost of attendance and repairs per year.	Total cost per year.	Cost per useful water horsepower hour. Fixed charges.	Fuel oil.	Attendance and repairs.	Total.	Cost per foot acre-foot. Fuel oil.	Total.	Cost per acre-foot of water pumped. Fuel oil.	Total.
		P. ct.												
25	.....	...	.....	.....	.....	.....	....	$0.046	.....	.....	$0.063	.....	$10.30	.....
26	.....	..	.....	.....	.....	.....	....	.026	.....	.....	.036	.....	3.40	.....
27	$10,000	16	$1,600	$2,760	$1,650	$6,010	$0.009	.015	$0.009	$0.033	.021	$0.045	4.48	$9.60
28	.....	..	.....	.....	.....	.....	....	.013	.....	.....	.018	.....	.....	.....
29	.....	..	.....	.....	.....	.....	....	.011	.....	.....	.015	.....	.....	.....
30	33,111	14	4,604	3,590	1,860	10,090	.012	.010	.005	.027	.014	.037	.19	.50
31	50,000	14	7,040	3,600	2,100	12,700	.022	.011	.007	.040	.015	.055	.15	.54
32								.012						
33	.....	..	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....
34	.....	..	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....
35	55,000	12	6,600	4,600	2,320	13,520	.007	.005	.002	.014	.007	.019	1.73	4.69
36	5,000	17	850	2,000	1,500	4,350	.019	.045	.034	.098	.062	.135	3.10	6.50
37	7,500	17	1,275	1,830	1,800	4,905	.016	.023	.022	.061	.032	.084	2.80	7.34
38	35,000	15	5,250	2,400	1,575	9,225	.048	.022	.014	.084	.030	.116	1.26	4.87

California.

On account of the great cost of wells, the total cost of plant bears no direct relation to the capacity of the pumping plant.

In many cases the charge for attendance and repairs on gasoline engines is merely nominal, but when there is a charge for attendance, it is of considerable importance, in comparison with the cost of gasoline. In nearly all the tests reported above the annual fixed charges for interest, depreciation, and taxes, computed at 20 per cent on the total first cost of the plant, far exceed the cost of gasoline, attendance, and repairs per year. This relation evidently depends upon the number of hours the pump runs per year. Since in many cases the pumps are used to supplement natural stream flow, the amount of use of the pumps fluctuates from year to year. Hence the interest on the pumping plant is in the nature of insurance on the crop, and it is scarcely fair to charge this item in its entirety as cost of pumping.

The cost has been reduced for purposes of comparison to cost per useful horsepower hour under the items fixed charges, gasoline consumed, attendance and repairs, and total, and to cost per foot-acre-foot under the items gasoline consumed, and total. The latter are obtained from the corresponding items under the cost per useful water horsepower hour by multiplying by 1⅛. The last columns of the table give the cost per acre-foot of the water actually pumped under the headings of gasoline consumed and total. These are obtained from the preceding columns by multiplying in each case by the lift. These results are interesting as showing what it is actually costing irrigators in Southern California to pump water.

Electrically-driven Pumps.

Tests numbered 12 to 24 are for electrically-operated pumps. Nos. 12 to 18 are centrifugal pumps, arranged in order of useful water horsepower output, No. 19 is a screw pump, Nos. 20 and 21 are deep-well pumps, No. 22 is a triplex pump, and Nos. 23 and 24 are two tests on the same rotary pump. The electrically-operated pumps tested had approximately the same range in size as the pumps run by gasoline engines. The results are summarized here:

As a rule, the plant efficiency for the electrical pump is definitely higher than for a corresponding plant operated by gasoline. This is probably largely due to the fact that less energy is absorbed in the motor than in a gasoline engine. There is less variation in efficiency due to size of plant for an electrically-operated plant than for a gasoline plant. In test No. 15 the efficiency was abnormally low. The motor was running hot and the pump likewise seemed to be working badly, but it was not possible to tell by external inspection the reasons for the very poor performance of this plant. In tests Nos. 15, 16, 17, and 18, the pumps were compound centrifugals, a comparison of the efficiencies of which indicates that compound pumps are not necessarily any less efficient than single-stage pumps. Omitting from consideration No. 15, we may conclude that the plant efficiency of electrically-operated pumps should at least be as good as 40 per cent for a pump of 5 useful water horsepower capacity, increasing to 55 per cent for a pump with capacity of 40 useful water horsepower.

As compared with centrifugal pumps, test No. 19 shows the screw pump to be less efficient; tests 20 and 21 show the deep-well pumps to have about an equal efficiency; tests 22, 23, and 24 show the triplex and rotary pumps to have somewhat higher efficiencies, but no very conclusive statements can be based on so few tests.

The table shows that under the best conditions the smallest plants require about 1.6 kilowatts per useful water horsepower, and the largest about 1.4 kilowatts.

Steam-driven Plants.

Tests numbered 25 to 38 are of steam-driven pumping plants. Nos. 25 to 32 have centrifugal pumps, Nos. 33 and 34 are plunger pumps, Nos. 36, 37, and 38 are air-lift pumping plants. Test No. 30 is based on Nos. 28 and 29, running simultaneously, and similarly No. 35 consists of Nos. 33 and 34 running together. All these plants burn crude oil as fuel. The largest ones are very much larger than any of the gasoline or electric plants tested, and hence not strictly comparable with them. A summary of these tests follows:

For the plants using centrifugal pumps the plant efficiency does not seem to differ definitely from the efficiency for gasoline or electric plants. The plant efficiency of the plunger pumps is much higher than for any other type, while for the air-lift plants it is very much lower.

The amount of crude oil consumed varies from over 0.8 gallon per indicated horsepower hour for the smallest plant, to a little over 0.2 gallon for the largest plants. For those using centrifugal pumps the amount of crude oil used per useful water horsepower hour varies from 2.5 gallons for the smallest plant, to about 0.5 gallon for the most economical plants. A comparison with gasoline engines for corresponding size shows that at least four times as much crude oil is required when burned under a steam boiler as is needed of gasoline when used in an internal-combustion engine. When steam plants run intermittently, considerable fuel is required in getting up steam preparatory to starting the plant, so it is probable that in such cases the actual performance of the plants required more fuel in proportion to the work done than is shown in the tests.

A comparison of the results obtained with centrifugal pumps using gasoline, electricity, and steam as motive power, shows that, at the prevailing prices, to raise 1 acre-foot of water 1 foot the cost of gasoline varies from 1½ to 5 cents, the cost of electricity varies from 4½ to 10 cents, and the cost of crude oil for generating steam varies from 1½ cents upward. The total cost, according to the rates used for fixed charges and the figures obtained for attendance and maintenance, of raising 1 acre-foot of water 1 foot for gasoline plants varies from 4 cents upward, for electric plants it varies from 7 to 16 cents, and for steam plants it varies from 4 cents upward.

Tests 2 and 12 afford a direct comparison of the use of gasoline and electricity. The pump and piping were the same in the two tests, but the speed of the pump was slightly higher when run by the electric motor, resulting in an increased discharge from the pump. This would be a possible source of discrepancy in the results. The figures show for this plant the cost of gasoline to raise 1 acre-foot of water 1 foot high to be 3.7 cents, and the cost of electricity to be 6.9 cents; while the total cost for the gasoline plant is 6.9 cents, and for the electric plant 8.8 cents per foot-acre foot.

Tests 16 and 26 afford a direct comparison of the use of electricity and steam. The two tests were made in succession on the same plant under identical conditions. The results show the cost of electricity per foot-acre foot of water pumped to be 5.2 cents, and the cost of crude oil for producing steam to be 3.6 cents.

Tests 23 and 24 were carried out on the same plant. In No. 23 the plant was working under favorable conditions. In No. 24 the pump was sucking air on account of a deficient supply of water. The results show that in this case having the pump too large for the water supply increases by about 10 per cent the charge for electricity per foot-acre foot of water lifted.

The JOURNAL of ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers' Architects' and Builders' News

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

SUCCESSORS TO
The Journal of Electricity Publishing Company
304 Atlas Building, San Francisco.

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00.
Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

EASTERN AGENCIES

NEW YORK .....
CHICAGO .....
ST. LOUIS .....

WESTERN AGENCIES

LOS ANGELES .....
PORTLAND .....
SEATTLE .....

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XIX AUGUST 31, 1907 No. 9

EDITORIAL.

FOR PRINCIPLE.

The successful establishment of the principle of industrial freedom in the operation of two of the great public utilities of San Francisco has not been accomplished without grave cost and bitter contest. It has only been by unswerving devotion to this principle that the fight has been won, and that devotion has been strengthened by the foresight that unless the sacred rights of free labor were defended and maintained in these issues, the future peace and prosperity of San Francisco would be perpetually menaced.

Throughout the sixteen weeks of warfare between the United Railroads and organized labor all sorts of inducements, and from all quarters, have been held out to Mr. Calhoun to recede from the position which he had taken at the outset—that he would never again recognize the Union which had wantonly broken faith with him and violated its own general laws. The strike precipitated a reign of lawlessness, of intimidation, riot, bloodshed and boycott. Such conditions forced Mr. Calhoun to become the champion of that individual liberty which has so long been denied in the operation of industries in San Francisco by the forces of organized labor.

The injustice and unreasonableness of the carmen's strike was decided long ago. Indeed, many of the leaders of organized labor have themselves admitted that it was "ill advised," but have stultified themselves by continuing to support it with all the unlawful weapons in their power. Their fight has been irrespective of the rights or wrongs of the carmen, but has been impelled by the conviction that the victory of the United Railroads meant the establishment of the principle of the "open shop" in San Francisco and the death-knell to the tyranny of labor unionism. And thus for some weeks the issue has been by no means confined to any trouble between the United Railroads and its employes, but to the broad general lines of industrial freedom. As far, indeed, as the "settlement" of the street car strike is concerned, that was settled long ago, just as soon as the United Railroads proved its ability to operate its cars and to serve the public without dependence upon organized labor. Under such conditions it was unfortunate that the Mayor of San Francisco, doubtless with the best intentions possible, considered it desirable to invite Mr. Calhoun to confer with the president of the Labor Council "with a view to the settlement of the strike." In the first place, it should have been recognized that nothing now remains for the United Railroads to settle with the striking carmen. Over and over again Mr. Calhoun has stated the willingness of the United Railroads to take back into its employ those who are willing to come as individuals. The only thing that remains to be settled is that organized labor should call off its unlawful boycott of the United Railroads and of free individuals who choose to patronize its cars.

In declining to meet the president of the Council of Labor, Mr. Calhoun once more reiterated his position and proved his rigid adherence to the principle of industrial freedom and to the preservation of law and order. He pointed out that the president of the Council of Labor and his associates are the champions of the false and unlawful doctrine that "where laborers voluntarily leave their employers because the employers will not submit to their demands, however unjust, and call a strike which the leaders themselves pronounce improper, their former employers may be prevented by violence from employing other free labor to take their places, and that other laborers may be coerced by violence from accepting such employment; in other

words, these present labor leaders are standing for the doctrine that force, violence and coercion may be employed by organized labor both against the employer and against other laborers that are willing to work." Mr. Calhoun rightly concluded that his meeting with such leaders and discussing with them any concession would necessarily involve a recognition of the unlawful doctrine for which they stand.

Such action and argument are irrespective of any consideration of policy, cost or convenience. They are inspired and maintained solely by adherence to a vital principle, of which there can now be no abandonment.

PUBLICATIONS RECEIVED.

The Electric Controller and Supply Co., Cleveland, Ohio, send a neat brochure on Universal Insulator Supports.

September "Sunset" is a creditable reflection of what is being done in the West and by Westerners. The contents include "The Invasion of Oxford," by W. C. Crittenden; "The Northwest's Exposition," "The Spread of San Francisco," "A Pocket Empire—Napa," "In the Twin Falls Country," "About Baker City," besides the usual interesting fiction. All are beautifully illustrated and typographically attractive.

Proceedings of the American Institute of Electrical Engineers for July, 1907, besides the usual note and comments, contains the following papers, discussions, and reports:

Single-Phase vs. Three-Phase Generation for Single-Phase Railways, by A. H. Armstrong. The Choice of Frequency for Single-Phase Alternating-Current Railway Motors, by A. H. Armstrong. Twenty-five vs. Fifteen Cycles for Heavy Railways, by N. W. Storer. The Attitude of the Technical School toward the Profession of Electrical Engineering, by H. H. Norris. Standardization Rules. On the Concentric Method of Teaching Electrical Engineering, by V. Karapetoff. Deflocculated Graphite, by Edward G. Acheson. Some Facts and Problems Bearing on Electric Trunk-Line Operation, by Frank J. Sprague. The Rowland Telegraphic System, Discussion at New York, April 15, 1907.

CENTURY-KLEIN ELECTRIC CO.

Mr. F. M. Greenwood and Mr. W. L. Goodwin have acquired the interests in the Century-Klein Electric Company formerly held by Messrs. C. M. Wood, A. G. Stoll and E. F. Weihe. Mr. F. M. Greenwood continues as president of the company, Mr. W. L. Goodwin as vice-president and manager, and Mr. F. L. Sullivan as secretary. It is the intention of the company to extend its scope of operations, and to carry at all times a complete stock of electrical supplies. Notice of permanent location will be announced later.

TRADE NOTES.

The Platt Iron Works has moved its office and salesrooms from Monadnock Building to 509 Market Street, San Francisco. Their new and commodious quarters give them increased facilities.

The Pacific Coast sales headquarters of the Benjamin Electric Mfg. Co. have been moved from 157 Minna Street to 656 Howard Street, San Francisco, where they have a large stock of electrical supplies ready for immediate delivery.

PERSONAL.

Harry F. Reynolds has opened an office as electrical engineer and contractor at 656 Empire Building, Seattle, Wash.

Irving W. Phillips has been appointed superintendent of the North Mountain power plant, at Junction City, Trinity County, Cal.

Geo. J. Henry, Jr., engineer for the Pelton Water Wheel Co., has returned to San Francisco after a three months' trip East.

A. A. Martin, vice-president and general manager of the Pacific Power Co., was in San Francisco this week from Red Bluff, Cal.

Mr. A. J. Turner, formerly with Chas. C. Moore Co., Inc., has joined the engineering staff of Henshaw, Bulkley & Co., of San Francisco.

F. H. Poss has been made manager of the Pacific Coast department of the Holophane Company. The local sales department at 656 Howard Street, San Francisco, is in close touch with the engineering staff in New York, and is prepared to figure on scientific lighting of all kinds.

Messrs. C. M. Wood and E. F. Weihe, formerly of the Century-Klein Electric Company, of San Francisco, have taken over the Century Electric Company, of Alameda County, Oakland, and will in future devote their entire time to that company. They have the "Journal's" best wishes for their future success.

R. S. Masson, formerly consulting electrical engineer of this city and Los Angeles, has re-established offices at 804 Union Trust Building, representing the Electric Operating Construction Company, of 49 Wall Street, New York. This company is prepared to undertake the management of the operation of electric properties. It will provide necessary funds to improve or rehabilitate existing properties when desired, or to establish new enterprises, and will also engineer the necessary construction work.

E. G. Dewald, manager of the Platt Iron Works, of Dayton, Ohio, is visiting the Pacific Coast, and states that he has secured the order for the fifth unit for the Post Falls plant of the Washington Water Power Co., of Spokane, Washington. He was also awarded the contract for the Mt. Hood Railway & Power Company, Portland, Oregon, for the water wheel, which will be 13,000 horsepower, and will be direct connected to the generator, running at 514 revolutions per minute; also the contract for the city of Seattle for the Cedar River plant, which will consist of two units, 8,000-horsepower Francis turbines, which are operated under 600-ft. head, and which will run 600 revolutions per minute, and will be direct connected with the generator. Lombard governors will be used on all these installations.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	AUGUST 23		AUGUST 24		AUGUST 26		AUGUST 27		AUGUST 28		AUGUST 29	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%	78	80	78	80	78	80	78	80	78	80	78	80
2,250,000	M & S	Bay Counties Power Co. 5%	95	.....	95	95½	.....	95½	.....	.....	.....	95½	.....	95½
1,000,000	F & A	Cal. Central Gas & El. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	.....	80	.....	80	.....	80	.....	80	.....	80	.....	80
900,000	J & J	California St. Cable Co. 5%	.....	102½	.....	102½	.....	102½	.....	102½	.....	102½	.....	102½
2,000,000	J & J	Contra Costa Water Co. 5%	.....	100½	.....	100½	.....	100½	.....	100¼	99	100	99	100
1,000,000	J & J	do do Gen. Mtg. 5%	.....	96	.....	96	.....	96	.....	96	.....	96	.....	96
623,000	F M A N	Edison Light & Power 6%	108½	111	108½	111	109	112	109	112	109	112	109	112
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	.....	108½	.....	108½	.....	108½	.....	108½	.....	108½	.....	108½
671,000	A & O	Geary St. Ry. 5%	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
610,000	M & N	Honolulu R. T. & L. Co. 6%	105½	.....	105½	.....	105½	.....	105½	.....	105½	.....	105½	.....
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%	.....	102½	.....	102½	.....	102½	.....	102½	.....	102½	.....	102½
500,000	J & J	Los Angeles Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
5,000,000	A & O	Los Angeles Ry. 5%	108½	110	108½	.....	108½	.....	108½	.....	108½	.....	109½	.....
1,000,000	A & O	Los Angeles Lighting Gd. 5%	.....	103	.....	103	.....	103	.....	103	.....	103	.....	103
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	102¾	.....	102¾	.....	102¾	103¼	102¾	103¼	102¾	103¼	102¾	103¼
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%	.....	101	.....	101	.....	101	.....	101	.....	101	.....	101
3,000,000	J & J	Market Street Cab'e 6%	.....	108	.....	108	.....	108	.....	108	.....	108	.....	108
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%	102½	104	.....	104	102¾	.....	102¾	.....	101	105	102¾	.....
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103	.....	103	.....	103	.....	103	.....	103	.....	103	.....
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	113	.....	113	.....	113	.....	113	.....	.....	113	.....	113
1,498,000	J & J	North Pacific Coast R. R. 5%	101	.....	101	.....	101	.....	.....	101½	.....	101½	100	101½
1,074,000	J & D	Northern Cal. Railway 5%	105	.....	105	.....	105	.....	105	.....	104	.....	104	.....
980,000	J & D	Northern Cal. Power Co. 5%	.....	97	.....	97	.....	97	.....	97	.....	95	.....	95
6,000,000	A & O	Northern Electric Co. 5%	.....	97½	.....	97½	.....	97½	.....	97½	.....	97½	.....	97½
1,000,000	M & S	Oakland Gas Light and H. 5%	.....	106	.....	106	.....	106	.....	106	.....	.....	.....	.....
1,374,000	J & J	Oakland Transit Co. 6%	109	.....	.....	.....	109½	.....	109½	.....	109½	.....	109½	.....
1,600,000	J & J	Oakland Transit 5%	104	.....	104	.....	104	.....	104	.....	104	.....	104	.....
1,326,000	J & J	Oakland Transit Con. 5%	.....	103	.....	103	.....	103	.....	103	.....	103	..	103
7,000,000	J & J	Oakland Traction Con. 5%	.....	99½	.....	99½	.....	99½	.....	99½	.....	99½	.....	99½
1,500,000	J & J	Oakland Water Co. gtd. 5%	.....	99½	.....	99½	.....	99½	.....	99½	.....	99½	.....	99½
2,000,000	A & O	Omnibus Cable Ry. 6%	.....	112	.....	112	.....	112	.....	112	.....	112	.....	112
1,149,000	S D M J	Pacific Gas Imp. 4%	.....	92½	.....	92½	.....	92½	.....	92½	.....	92½	.....	92½
8,494,000	J & J	Pacific Electric Ry. Co. 5%	.....	104¾	.....	104¾	.....	104	.....	104	.....	104	.....	104
4,491,000	J & J	Pacific Light & Power Co. 5%	.....	98	.....	98	.....	98	.....	98	.....	98	.....	98
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%	.....	103	.....	103	.....	103	.....	103	.....	103	.....	103
350,000	J & J	Park & Cliff House Ry. 6%	.....	104	.....	104	.....	104	.....	104	.....	104	.....	104
250,000	J & J	Park & Ocean R. R. 6%	.....	104	.....	104	.....	104	.....	104	.....	104	.....	104
700,000	M & S	Powell Street Railway 6%	.....	107½	.....	107½	.....	107½	.....	107½	.....	107½	.....	107½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%	.....	101¼	100¾	101½	100	101¼	100	101	100	101	100	101
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	.....	113	.....	113	112	113	.....	113	112¼	113	112½	113
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	103½	.....	103½	.....	103½	.....	103½	.....	.....	.....	105	103½	105
1,500,000	J & J	do do 2d Mtg. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
642,000	A & O	Sierra Ry. of Cal. 6%	104¾	.....	104¾	.....	104¾	.....	104¾	.....	104¾	.....	104¾	.....
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	101	101¼	101	101¼	101	.....	101	.....	101	.....	101	.....
4,000,000	J & J	do do do (1910)	101¾	.....	101½	.....	101¾	.....	102	102½	102	.....	102	.....
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	108	.....	108	.....	108	.....	108	.....	108	.....	108	.....
4,127,500	M & N	S. P. R. R. of Cal., 1st c. gtd. 5%	114	.....	114	.....	114	.....	114	.....	.....	118	.....	118
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	124	.....	124	125½	124	125½	123½	.....	123½	125	124	125½
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	89½	.....	89½	.....	89	.....	88½	.....	88¾	89	88¾	88¾
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%	85	87	85	87	85	87	85	87	84¾	85	85	.....
300,000	M & S	Stockton Gas & Elec. Co. 6%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
2,000,000	J & J	United Gas & Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
20,000,000	A & O	United R. R. of S. F. 4%	70¼	70⅝	70¼	70½	70	70⅜	70	.....	70⅜	70¾	70¼	70¾
2,500,000	M & N	Valleys Counties Power Co. 5%	.....	100	.....	100	.....	100	.....	97½	.....	96½	.....	95½
		Water Stocks.												
.....	.....	Contra Costa	.....	62	.....	62	.....	62	.....	62	.....	62	.....	62
6,000	Quarterly	Marin County	.....	60	.....	60	.....	60	.....	60	.....	60	.....	60
280,000	.....	Spring Valley Water Co.	20¼	20½	20⅝	20⅞	20¾	21¼	21	21¼	22⅜	23	23½	24
		Gas and Electric Stocks.												
37,500	.....	Martel Power Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9,340	.....	Mutual Electric Light Co. (Ctfs.)	4½	.....	4½	.....	4½	.....	4½	.....	4½	.....	4½	.....
37,336	.....	do (Extended Ctfs.)	12¾	.....	12¾	.....	12¾	.....	12¾	.....	12¾	.....	12¾	.....
40,000	Monthly	Pacific Lighting Co.	65	.....	65	.....	65	.....	65	.....	65	.....	65	67½
12,000	.....	Stockton Gas & Elec. Co.	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
		Street Railroad Stocks.												
10,000	.....	California	.....	140	.....	140	.....	140	.....	140	.....	140	.....	140
10,000	.....	Geary	.....	30	.....	30	.....	30	.....	30	.....	30	.....	30
10,000	.....	Presidio	.....	25	.....	25	.....	25	.....	25	.....	25	.....	25
	Semi-an.	Associated Oil Co.	29⅝	29⅞	29⅝	30	29	29½	28	29	28½	29	.....	28
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.	.....	110	.....	110	.....	110	.....	110	.....	110	.....	110
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)	82½	85	80	85	80	85	80	85	80	85	80	85
180,000	.....	Pac. Tel. & Tel. Co. (Common)	10⅝	12⅛	11	.....	11	.....	11	12⅛	.....	.....	11	12

Unlisted Securities

750,000	A & O	Bay Counties Power Co. 6%	97	.....	97	.....	97	.....	97	.....	97	.....	97	.....
745,000	M & S	Blue Lakes Water Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,000,000	A & O	California Northwestern Ry. 5%	.....	108	.....	108	.....	108	.....	108	.....	108	.....	108
160,000	J A J O	Marin County Water 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
600,000	J & J	Risdon Iron Works 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
500,000	M & S	S. F. Dry Dock 5%	.....	109	.....	109	.....	109	.....	109	.....	109	.....	109
8,000,000	M & N	S. F. Gas & Electric 4½%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
3,926,000	J & J	S. F. & North Pacific Ry. 5%	104	.....	104	.....	104	.....	104	.....	.....	105	.....	105
5,500,000	J & J	South Pacific Coast Ry. 4%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
.....	.....	Standard Electric Co. 5%	.....	80	.....	80	.....	80	80	80	.....	80	.....	80
.....	.....	do do Gtd. 5%	.....	85	.....	85	.....	85	.....	85	.....	85	.....	85
750,000	J & J	Sunset Tel. & Tel. Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%	.....	103½	.....	103½	.....	103½	.....	103½	.....	103½	.....	103½
1,000,000	M & N	Sutter Street Railway 5%	.....	104	.....	104	.....	104	.....	104	.....	104	.....	104
		Stocks.												
50,000	Monthly	Gas Consumers' Association	.....	20	.....	20	.....	20	.....	21	.....	21	.....	21
100,000	Monthly	Northern Cal. Power Co.	24¼	25	24¼	25	24¼	25	24¼	25	24¼	25	24¼	25
.....	.....	Pac. Gas & Elec. (Pfd.)	42½	.....	42½	.....	42½	.....	42½	.....	42½	.....	.....	46
.....	.....	Santa Cruz Port. Cement	.....	50	.....	50	.....	50	.....	50	.....	50	.....	50
.....	.....	Standard Port. Cement (New)	.....	55	.....	55	.....	55	.....	55	.....	52½	.....	52½
50,000	Monthly	Truckee Electric Co.	14½	15½	14½	15½	14½	15½	14½	15½	.....	15½	.....	15½

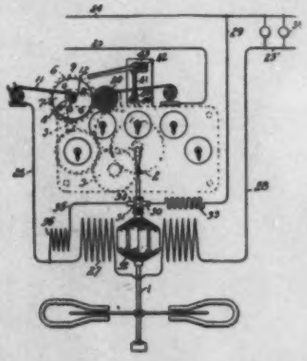
PATENTS

Electric, Gas and Water.

Specially reported for the Journal of Electricity, Power and Gas.

PREPAYMENT MECHANISM. 863,225. Ernest Schattner, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York. Filed December 2, 1904. Serial No. 235,149.

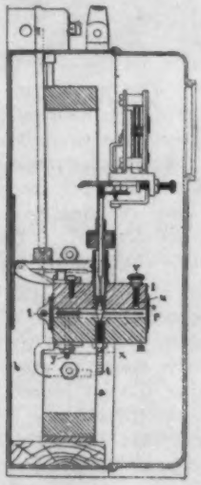
In a prepayment device, a contact device, a rotating shaft, a contact member loosely mounted thereon and engaging said first mentioned contact device to close an electric



circuit, a spring having one end secured to said shaft and the other end to the contact member carried thereby under sufficient tension to rotate said movable contact device away from its position of engagement with the contact device when released by it and again into engagement with said device, and a coin-controlled lock normally in a position to prevent the engagement of the member and device.

ELECTRICITY MOTOR-METER. 862,916. George Hookham, Birmingham, England. Filed November 6, 1906. Serial No. 342,275.

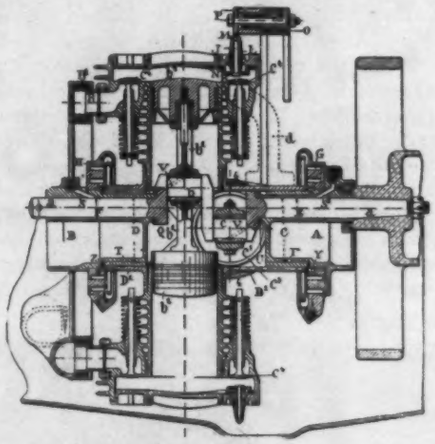
In an electricity meter in combination, a mercury cham-



ber, mercury in said chamber, an armature in said chamber, a magnet, pole pieces on said magnet, said pole pieces projecting into said chamber, means for reducing fluid friction between the mercury and the pole pieces on said magnet, and means for preventing the passage of current through the magnet; as set forth.

ROTARY MOTOR OPERATED BY GAS OR HYDROCARBONS. 863,355. Mathieu J. Burlat, Joannes Burlat, Joannes E. Burlat, and Joseph A. Burlat, Villeurbanne, France. Filed September 27, 1906. Serial No. 336,492.

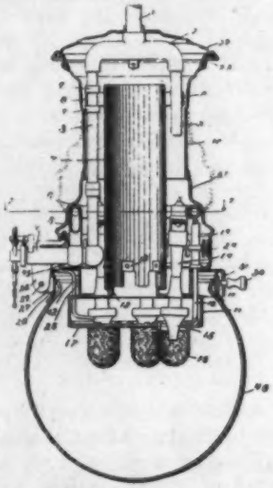
In a rotary gas or hydrocarbon motor the combination of a plurality of cylinders located radially about and adapted to revolve around a center, pistons working in said cylinders, connecting rods secured to said pistons, a crank shaft to which said rods are coupled in pairs, said crank shaft having



its axis eccentric to said center to an extent equal to a quarter stroke of the pistons aforesaid, inlet and exhaust valves communicating with said cylinders, eccentrically grooved cams, and means engaging the grooves in said cams for operating the valves during the rotation of the cylinders, substantially as described.

GAS LAMP. 863,182. Alfred H. Humphrey, New York, N. Y. Filed June 6, 1907. Serial No. 377,651.

In a gas lamp, the combination with a gas delivery pipe, of a chimney; a flange or deflector plate arranged at the lower end thereof, said flange or deflector plate being provided with a downwardly-projecting rim at its outer edge and with a central opening, said central opening being provided with a rim projecting into said chimney, said deflector plate and chimney being arranged so as to permit the passage of air above said deflector plate into said chimney;



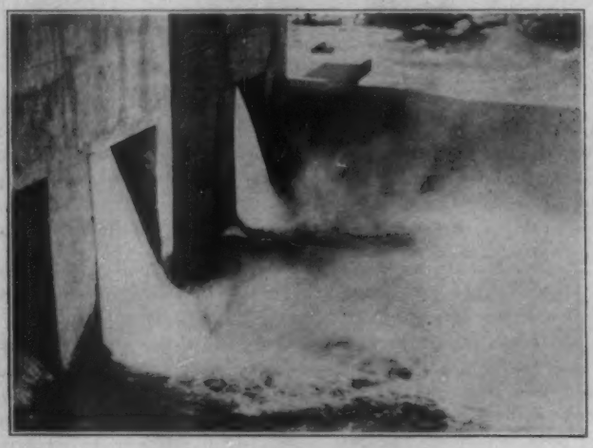
straps on said upwardly-projecting rim on said deflector plate secured to said chimney; a plurality of inverted burners provided with valves and burner tips arranged through said deflector plate with their tips below the same and within the downwardly-projecting rim thereof, and their valves above the same, said burners being connected to said gas delivery pipe; and an outer casing open at its upper end and provided with air inlets at its lower end.

INDUSTRIAL

REGULATION OF THE KERN RIVER PLANT NO. 1.

Kern River Station No. 1 of the Edison Electric Company, of Los Angeles, from which is developed enough power to double the capacity of all the Edison Company's other plants combined, is located far up in the lower Sierras of California, whence, through a wonderful channel, comprising twenty tunnels in all, water is led down twelve miles from the mountains for a fall of nearly a thousand feet and hurled against the four great Allis-Chalmers impulse wheels, aggregating over 40,000 horsepower and direct-connected to electric generators, with which the plant is equipped.

The engineering problems involved in building tunnels, flumes, penstocks and power houses to endure the heavy



WHEEL DISCHARGE

strains put upon them, were no more difficult to solve than the transmission of the electrical output from the new station under a pressure of 75,000 volts over a distance of 117 miles to Los Angeles. The route of transmission lies through the canyon in a direct line, thence over the hills, plains and divide, to follow the course of the Piru River and its tributaries. Large galvanized iron towers carry the heavy wire cables of the transmission line.

In many respects the Kern River development is unique. It is claimed to be the largest hydraulic electric plant west of Niagara. The transmission line is one of the longest in the world. The pressure of 75,000 volts over such a length of cable is the highest ever attempted. The conduit which leads to the pressure main is the longest underground tunnel system in use for this purpose. The concrete encased penstock tapering so as to accelerate the force of the water at the power house, is said to be the first of its kind ever placed in service.

The four big wheels which convert hydraulic to electrical energy, were built by Allis-Chalmers Company of Milwaukee and have each a capacity of 10,750 horsepower at full gate and a speed of 250 revolutions per minute, when operating under a net effective head of 865 feet. In addition to the main turbines there are two exciter turbines, also of Allis-Chalmers design, each with a capacity of 450 horsepower and a speed of 430 revolutions per minute.

The generator units are of the impulse type, with hand adjustable needles and governor-operated deflecting nozzles. Each unit has two runners, one on either end of the generator shaft. The interchangeable buckets are made of non-corrosive phosphor bronze of special mixture for the high head and are attached to the cast-steel discs bolted to the flanged ends of generator shaft. These discs of cast steel furnish sufficient fly-wheel effect to supplement the amount contained in the generator, in order to meet the guarantees of speed regulation. (For sudden changes of load, amounting to twenty-five per cent, fifty per cent and one hundred per cent, it is guaranteed that the speed variations will not exceed 1.7 per cent, 3.5 per cent, and 7.8 per cent respectively.)

The nozzles are provided with hand-adjustable needle and arranged to be deflected by the governor automatically, or by the latter's hand-regulating device. By deflecting the jet, instead of regulating its discharge by adjusting the

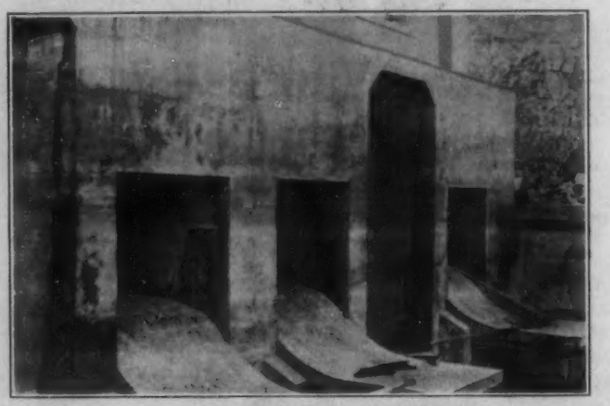


PLATE DEFLECTORS

needle with the governor, it is possible to secure a constant velocity of water in the pipe-line, as well as a constant discharge of water into the tail-race, even when the plant is operating with heavy fluctuations of the commercial load.

The nozzles are of the best quality of cast steel. Special attention may here be called to the design, which has a number of new features. The nozzles consist of two "Y" pipes, flanged together in such a way that the whole nozzle has a diamond shape. The up-stream end of the nozzles forms the movable part of the knuckle joint and the down-stream end carries the nozzle tip. By making the nozzle diamond shaped, the following advantages are obtained:

1. The center of the jet corresponds to the center of inlet pipe; therefore, any reaction from the jet upon the needle and nozzle is not eccentric. This is of importance with deflecting nozzles, where any variable reaction upon the governor should be avoided.

2. As the two branches of the "Y" join at ample distance from nozzle tip, the water has time to gather concentrically around the needle under an absolutely uniform pressure. The result is that the jet leaves the nozzle tip at a high velocity and without disturbance.

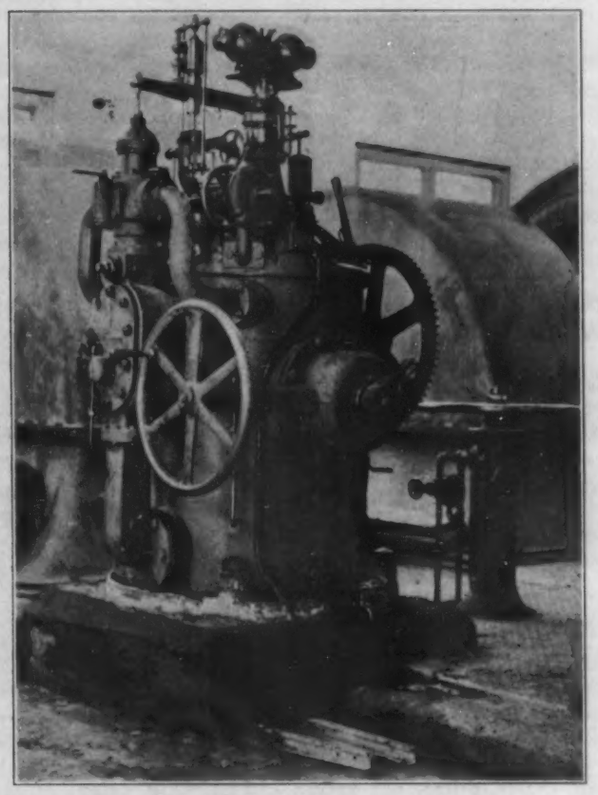
3. Due to the fact that the jet leaves the nozzle tip uniformly, the needle is axially balanced and not subject to any vibration.

4. The needle stem not being subject to any bending, it need not be made slender and flexible, but is made very substantial. The end of the stem projecting through the front "Y" pipe is of smaller diameter than the stem. The differential room thus formed can be put under adjustable water pressure. This pressure tends to close the needle and

puts all pins and links of the connection in a position for hand adjustment under slight pressure in the closing direction. By this, any rattling of the needle is prevented.

The upstream end of the nozzle forming the movable part of the knuckle joint is hooked into the stationary part, or swivel-head. The swivel-head is heavily bolted to the foundation, as it has to take up the full pressure of 375,000 pounds, tending to pull the nozzle away downstream. This pressure is taken up by two steel pins carefully fitted into their bearings and provided with suitable lubrication.

A 28-inch gate valve is connected to the swivel-head and controlled either by hand or electrically by a motor operated from the switchboard. All parts of this gate sub-



GOVERNOR

ject to the operating pressure are made of the best quality of cast steel. The gate is single seated and bronze lined.

The needle consists of a hollow stem of cast steel, into which is screwed and secured the steel needle tip. A heavy cast-iron base plate, grouted and rigidly bolted to each side of the generator base frame, forms the solid foundation for the cast-iron wheel housing. These housings are made very substantial in order to avoid resounding. They are divided horizontally along the center line of shaft, thus allowing easy removal for inspection or for replacing the buckets. The sides of the housing have extensions of removable steel plates, which protect the concrete against the impact of the discharging water. The pits in which the deflecting nozzles are located are of sufficient width to allow passage on either side. They are covered with substantial cast-iron floor plates, made in sections of such size as to permit of easy removal.

Another feature of these impulse wheels deserves comment on account of its novelty. As already mentioned, the regulation of the wheels is effected by a governor which deflects the jets of the two nozzles. The needles are adjusted by hand and are usually set to that maximum size of jet which will be sufficient to develop the maximum peak load expected for that period of setting of the needles. In other words, there is always a maximum amount of water leaving the nozzles. The governor adjusts the deflecting nozzle in such a way that only as much water is directed upon the buckets as is needed for the load for the time being. The balance discharges below the buckets into the tail-race. It is evident that, at times, when all load is thrown off the wheels, the governor will deflect the jets entirely. Each jet has a maximum diameter of 7⅛ inches and leaves the nozzle tip at a velocity exceeding 225 feet per second. It was, therefore, necessary to provide means of receiving this tremendous power and deflect the jet into the tail-race in such a way that its impact would not be detrimental to the parts against which it is directed. This has been successfully accomplished by the present arrangement of deflectors. It consists of an upper channel heavily ribbed and bolted to the concrete foundation, and of a lower bottom plate. The channel at its upper end is slightly more inclined than the deflected jet. Thus the jet will strike the bottom of the channel under a small angle and therefore tend to spread and fill the section of channel. The channel gradually widens and consequently the jet is offered a larger resistance area. The lower part of the channel is curved and at its end the jet discharges almost perpendicular. The bottom plate is "S" shaped, its upper end being flush with the bottom of the wheel pit, the lower end being practically level. The jet strikes the bottom plate almost in the turn of the "S" and under a small angle. Thus the jet is again forced to spread and follow the base of bottom plate. In due consideration of the unavoidable wear and tear of these deflectors, they are lined with removable steel plates wherever the surfaces are exposed to the flow of the deflected jet.

The exciter units are also of the impulse type, with hand adjustable needles and governor-operated deflecting hoods. Each unit has one runner overhung on one end of exciter shaft, the other end carrying a flywheel. The interchangeable buckets are bolted to a cast-steel disc, which is keyed upon the exciter shaft. This disc and the flywheel furnish sufficient flywheel effect for the speed regulation guaranteed. The nozzle is stationary and "S" shaped in the horizontal plan and carries the stand and hand wheel for hand operation of the needle. The needle has a removable tip. A hand-operated gate valve is connected to the upstream flange of the nozzle. The base of the wheel housing is cast in one piece with the exciter base frame. The cast-iron wheel housing is split horizontally along center line of shaft. The sides of the base have extensions of removable steel plates which protect the concrete against the impact of the discharging water. The pits of the nozzles are covered with removable cast-iron floor plates.

The automatic regulation is effected by a governor which deflects the jet from the buckets, this, however, not being accomplished by deflecting the whole nozzle, but simply by inserting a hood which cuts into the jet from

underneath and directs this part of it directly into the tail-race. That part of the hood which deflects the jet is made of steel and is removable. Care is taken in designing this arrangement so that the knife edge of the hood does not disturb the working portion of the jet.

When the governor arrangement was designed, the leading idea was to have each turbine with its respective governor form an independent unit. Although the available operating water pressure of 370 pounds from the force main is ample to operate governors, it was preferred to substitute oil pressure. This precaution is fully justified, as long years of experience in operating hydraulic governors have proven that the safety is rather questionable, and the wear and tear of the parts of regulating valves causes a constant expense for repairing and replacing parts, which necessitates shutting down the respective units. It was also preferable not to feed the governors with oil pressure from a central system, but to make each governor absolutely self-contained.

Special attention was paid to the safe operation of the units, avoiding from the beginning any runaway. For this purpose, the arrangement of the generator, as well as the exciter governor, was made in such a manner that the jets will be automatically deflected from the buckets should the oil pressure in the governor fail.

The weight of each generator deflecting nozzle is partly carried by a hydraulic balancing piston, which receives water pressure directly from the force main. As soon as the oil pressure in the governor fails, the nozzle will lower on account of the unbalanced weight, and thus deflect the jet from the buckets. The same result is accomplished with the deflecting hood of the exciter wheels, which is connected to a hydraulic water piston, tending always to insert the hood and thus deflect the jet.

The governors are driven by a silent chain from their respective wheel shafts. The connections between the operating pistons and the deflecting nozzles or hoods consist of levers, pins, links and shafts, and the use of gears or racks has been avoided, thereby preventing the jars that result in lost motion and wear and tear.

Attention may also be called to the fact that all constituent parts, as well as all accessories, are attached or combined with one main casing, the advantage in this being that each governor can be assembled and thoroughly tested where built and shipped completely assembled to its final destination. The main casing contains the main operating cylinder with piston and mechanical hand-regulating device. The oil pump is attached to the casing and immersed in the oil reservoir. It is of the rotary type, having no valves, which are often the cause of failure of oil pressure. The main pump shaft also carries the bevel gear which drives the fly balls operating the pilot valve over the regulating lever. The pilot valve is self-contained between opposing pressures, and any reaction upon the flyballs is eliminated. It is evident that this is a condition of prime importance for exact regulation. The pilot valve distributed the oil pressure in the regulating cylinder. The motion of the regulating piston is reversedly transmitted to the regulating valve by means of a combined compensation. The leverage of this compensation is adjustable, so that the governor may be set to any change of speed between no load and full load, from sixteen per cent to absolutely constant speed.

The governors are equipped with four regulating devices which can be used at any time, viz.:

1. Mechanical hand regulation (without oil pressure).
2. Automatic regulation with fly balls.
3. Hand regulation with oil pressure (fly balls disconnected by a clutch coupling inserted between pump shaft and fly-ball shaft.
4. Hand regulation with oil pressure and electric motor operated from the switchboard. (Synchronizing attachment.)

The exciter governors are of similar design, except that they are not provided for electric hand regulation.

The Kern River installation of the Edison Company is but one of three water-power developments owned by this company, in addition to six or seven steam plants located within a radius of 200 miles, all of which will operate in synchronism. A portion of the output of this plant will be disposed of along the line to Los Angeles. A very considerable amount of power will be utilized in the city of Santa Barbara. The demand for power in Los Angeles, Santa Barbara, and San Luis Obispo counties far exceeds the supply, and the output from this station will help to satisfy the general requirements rather than be devoted to any specific purpose. The Edison Company contemplates the building of plants Nos. 2, 3 and 4 on the Kern River, which will aggregate over 100,000 horsepower in addition to the output of the present station.

THOMSON POLYPHASE INDUCTION WATTMETERS.

Bulletin No. 4527, issued by the General Electric Company, Schenectady, N. Y., describes the latest form of these Thomson polyphase induction wattmeters, which are made in three types: one for house service, with metal cover, and two for switchboard use, one having a metal cover and the other a glass cover. The Bulletin gives catalogue numbers and capacities, etc., of the various sizes, and a large number of connection diagrams showing the method of installation on different classes of circuits.

ELECTRIC CRANE CONTROLLERS.

The Cutler-Hammer Mfg. Co., of Milwaukee, Wis., makers of electric controlling devices, have issued a booklet, pigeon-hole size, descriptive of their lines of electric crane controllers. In addition to full descriptions and illustrations of five types of crane and hoist controllers, the booklet contains connection and dimension diagrams, repair part charts, prices, net weight and shipping weight of apparatus, etc. An improved form of contractor for handling heavy currents is also described.

ALLIS-CHALMERS STEAM TURBINES AND ALTERNATORS FOR MUNICIPAL PLANTS.

The steam turbine, because of its many advantages over other forms of prime movers, is daily coming more and more into favor, especially for use in municipal lighting and power plants, where small floor space, absence of expensive foundations, comparatively small operating expense, and other well known characteristics of the steam turbine are important factors to be considered. Recently, contracts have been closed with two municipalities for Allis-Chalmers turbine units, one for the city of Columbus, Ohio, and one for the municipality of Dunkirk, N. Y.

The turbine for the city of Columbus is a 1,000-kilowatt Allis-Chalmers machine, direct connected to a 1,000-kilowatt alternator of the same design, wound for 60 cycles, 3-phase, 2,300 volts.

The municipality of Dunkirk unit is to be a 500-kilowatt Allis-Chalmers turbine, direct connected to a 500-kilowatt Allis-Chalmers alternator, wound for 60 cycles, 2-phase, 2,300 volts.

NEWS NOTES

ELECTRIC RAILWAYS.

Boise, Ida.—The Boise & Interurban Ry. will build eight miles of new line at a cost of $150,000. Material is on hand and work commenced.

Snohomish, Wash.—C. A. Barrow, superintendent of the Snohomish Valley Railway, says that a contract for fifty-five miles of construction from Snohomish to Renton, has been let to the Continental Construction & Engineering Co., of New York.

Seattle, Wash.—A deal is pending or has been made, though not yet public, for the sale of the Renton & Southern line, between Seattle and Renton, to the Seattle Electric Co. President Furth states that the acquisition of this line would have no effect upon the proposed extension of the Seattle electric line from Rainier Heights to Columbia City.

Seattle, Wash.—Seventeen miles of the Seattle-Everett Interurban Railway will be in operation by September 1, according to the statement of Fred Sander. The road has practically been finished between Ballard and Hall's Lake, and it remains only to lay less than three miles of rails. At present there are about 125 men at work on the line.

Valdez, Alaska—More than $100,000 was subscribed by the citizens of Valdez at a mass meeting for organizing the Alaska Home Railway Co. to build an electric road from Valdez to the interior. Construction begins immediately on wharves and terminals in the heart of the town. H. Reynolds, owner of the Alaska Coast Co., is heading the project.

Billings, Mont.—If present plans do not miscarry, Billings, Mont., and the surrounding country will be connected by electric lines, states a Montana report. Yegen Bros. of that city are behind the move, and the power that will be used on these lines will come from the new power house that the Yegen company has been putting up south of Billings. It is planned to connect Columbus, Laurel, Park City, Huntley and Bear Creek with Billings.

Albany, Ore.—A. Welch, manager of the Willamette Valley Co., who has petitioned the City Councils of Albany and Salem for electric railway rights through the streets of the towns, said he had every reason to believe that Salem and Albany would each grant franchises through their respective cities. Mr. Welch says the line will be built on to Eugene beyond a doubt, and that it will be a competitor of the Southern Pacific through the valley.

North Yakima.—After negotiations extending over several months, the differences between the stockholders in the local electric railway project have been settled, and the Yakima Transportation Co. is to have the franchise granted by the City Council. A. J. Splawn, president of the company, announces that construction work will be begun forthwith. Ties for the construction of three miles of railway are here, and rails for the same extent of road are on the way here, having passed through Minnesota two days ago. The company will endeavor to construct the railway as far as the fair grounds in time for the opening of the fair. The project includes the construction of a city system and transportation to valleys lying to the east and west of the city.

Seattle, Wash.—Merle J. Wightman announces that work on the interurban street car line between Seattle and Tacoma, by which it is proposed to make the run between the two cities in one hour, and which has secured a franchise to enter Seattle by way of Fourth Avenue, will begin in ten days. He says: "The capital stock of the company as reorganized will be $2,000,000, made up entirely of common stock. L. B. Stilwell, of New York, is our consulting engineer. He is also consulting engineer of the New York subways. Except in a few places and for short distances our right-of-way has been secured. We will have no trouble in getting the balance. We will have a loop at Pine and Stewart Streets in Seattle. From Fourth Avenue we will follow Spokane Street to Youngstown, and thence on a line having only a few tangents, to a point near Commencement Bay, where the line will turn east and then south to the 11th Street bridge, and this will land us on Pacific Avenue, Tacoma."

Murray, Ida.—Murray and the north half of the Coeur d'Alene mining district appears at last assured of railroad transportation, the lack of which alone has kept back the big mines of that section. On Thursday, August 15th, the Idaho Northern bids were opened at Wallace, Idaho, for the construction of 76 miles of railroad into the Murray district. The main line of road, which will be 33 miles long, will run from Kingston, a town on the O. R. & N., between Harrison and Wallace, up the north fork of the Coeur d'Alene River to Pritchard Creek, up Pritchard Creek to Murray, and six miles beyond Murray to the mines in Paragon Gulch. A branch of the main line will run up the North Fork from the junction of North Fork and Pritchard Creek. This branch will be 25 miles long, and will open up a rich timber and mineral country. A second branch will leave the main line where Beaver Creek joins the North Fork, and will run eight miles to the southeast, tapping Sunset Peak district. A third branch is projected to be run ten miles north from the point where Eagle Creek runs into Pritchard Creek. The construction of these lines will cost between $800,000 and $1,000,000.

WATERWORKS.

Los Angeles.—Sealed bids are being received by the Board of Water Commissioners of Los Angeles, for gate valves, as per specifications on file in the office of the Board.

Los Angeles.—Judge L. O. Ray of Rhyolite, Nev., is in New York to interest Eastern capital in a project for developing water. C. D. Simpson and Judge Ray have bought 780 acres at Ash Meadows, forty miles from Rhyolite and will lay seven miles of pipe to the Borax Smith road. Three pumping plants and a large reservoir will be put in the Funeral Range to supply the Greenwater and Lee districts and Bullfrog and Echo Canyon, through a gravity flow in 12-inch pipe. Three gasoline engines will be used. The Ash Meadows Company has $5,000,000 capital.

TRANSMISSION.

Eureka, Cal.—It is expected that the City Council, at its first meeting next month, will consider bids for the telephone franchise that will be advertised for sale.

Willows.—The directors of the Snow Mountain Power Company report excellent progress. The big sawmill of the company is running night and day, cutting lumber for the flume to be built. The line of this flume is now being surveyed.

Redding, Cal.—Herbert Bass is now the lessee of the Redding, Ingot & Wengler Telephone Company. He will begin immediately the construction of a through telephone line from Montgomery Creek to Redding for his own private use and that of the Great Western Gold Mining Company.

San Francisco.—The Pacific Telephone and Telegraph Company's executive offices were moved from Scott and Fell Streets to the third and fourth floors of the Shreve Building, corner of Post Street and Grant Avenue. The engineering, construction and bookkeeping departments have already moved to a building erected for the purpose at 140 New Montgomery Street.

Redding.—The electrical process smelter at Heroult-on-the-Pit has begun operations and will now be run without interruption. Four draughts of pig iron of six tons each have been turned out so far, and Shasta County is now on record as a regular producer of pig iron. Ten men to a shift are required at the smelter, in addition, of course, to the force of miners.

Carson, Nev.—The Nevada Consolidated Telephone Company, composed of local capitalists, was favored by the board of city trustees in the matter of franchises over the Salt Lake Company, and the Sunset service will soon have a formidable rival. The Nevada Consolidated now has lines running to many near-by towns. It will give the city two per cent of its gross income after two years and will have its line completed within a year.

Redding.—A claim to 120,000 inches of water measured under a 4-inch pressure of the McCloud River has been filed by William Ellery of San Francisco in the county recorder's office. Mr. Ellery wants the water for lighting purposes and as motive power for machinery, especially electrical machinery. He states his intention of building a dam eighty feet in height or more, and diverting the waters of the McCloud with this and with two canals on the east and west banks to two power houses.

Redding.—The Shasta Power Company has started sixty men at work on the three-quarters of a mile of ditch that is needed to make connections between the two completed stretches. The power company brought condemnation suit against Thomas B. Walker, the timber king, several months ago, and won out in the Supreme Court. Mr. Walker appealed and the U. S. Appellate Court sustained the decision of the lower court. The ditch that will carry the 3000 inches of water for the power plant of the Shasta Power Company will be five feet wide at the top, three feet wide at the bottom. Power will be furnished to Redding within a very short time.

Antioch, Cal.—The Great Western Power Company, which is spending several million of dollars in the construction of an electric power generating plant near Oroville, is also engaged actively in work in this county. The company's surveyors have passed through here and have reached a point near Concord. The river is to be crossed at this place and rights of way have been secured for steel towers which are to be erected 700 feet apart. From Sacramento the line will extend down the river section to a point opposite this city, where it will cross the stream. It will continue on to Concord with a branch at Martinez and a large substation at Point Richmond. The rights of way in this county are being purchased by Civil Engineer J. H. Hornung and are 100 feet wide. They extend through the orchards and farms of many wealthy land owners, but as far as is known Hornung is experiencing little difficulty in securing the desired land.

ILLUMINATION.

Fresno.—The Fresno Home Light and Power Company recently incorporated with $250,000 capital stock, will erect a $280,000 plant. The principal place of business is Fresno.

San Rafael, Cal.—Manager Wallace Foster of the San Rafael Gas and Electric Company, has a gang of men at work at the local station preparatory to erecting a 100,000-foot gasholder for San Rafael and vicinity.

Rhyolite, Nev.—The new light and power line from Palmetto to Rhyolite, recently constructed by the Nevada-California Power Company at a cost of $1,000,000, is nearly completed and the current will soon be turned on in Rhyolite.

Woodland, Cal.—The City Trustees have made arrangements with Manager Osborn of the Woodland Gas and Electric Company for the sinking of a new 14-inch well on the city's property. This well will take the place of the two 8-inch wells damaged by oil from the gas works.

the head of Packwood Lake, in the Cascade Mountains, is well under way, and some five miles of canal have already been built. The project involves the construction of a canal 50 miles long from Packwood Lake to a point above the Cowlitz River, where, at Snyder's Ranch, the power plant will be located. It is estimated that the water at this point will have a fall of 1,500 feet and will be capable of developing 100,000 horsepower.

San Francisco.—The lights and finance committee of the Board of Supervisors have voted to recommend the acceptance of the amended rates for gas and electric street lighting submitted by President Britton of the San Francisco Gas and Electric Company. The sum of 6.548 cents will be paid by the city for each street lamp per night, and 20.713 cents for each electric. Sixty cents is the rate agreed upon for the gas lighting of the public buildings. These amended figures will be submitted to the supervisors with the committee's recommendation that they be accepted and contract awarded accordingly. In addition to the 4210 gas lamps and the 1616 arcs now in operation at the above figures, the budget appropriation will permit the city to install 1300 more gas lamps in the burned district and 63 arcs, and then have about $10,000 of the fund left to expend on lights in the new districts. There will also be a certain redistribution of lights, taking some lights from localities where there is a superabundance and adding others for the unlighted portions of the city.

TRANSPORTATION.

Pasadena.—The Council has passed an ordinance calling for bids for a double-track electric line franchise on Colorado and other streets.

Los Angeles.—W. I. Hollingsworth asked the Board of Supervisors to advertise for sale an electric road franchise on certain streets in Playa del Rey, and this was ordered.

San Diego, Cal.—It is an assured fact that the Santa Fe Railroad Company will rebuild its line between Riverside and Temecula with heavy 80-pound steel rails in place of light ones and with new ties.

Las Vegas, N. M.—The committee appointed at the Commercial Club meeting for the purpose of raising $100,000 as earnest money for protection of the proposed electric railroad to Hora, raised $40,000 of desired amount at a meeting recently held.

San Jose.—The Board of Supervisors received tenders for the franchise for an electric railroad on Park Avenue and the Meridian Road at its last meeting. The tender of the San Jose-Los Gatos Interurban Railway was read, offering $50 for the franchise, and it was ordered that the bid be accepted.

San Francisco.—The city attorney has been instructed by the Board of Supervisors to defend the city in the suits brought by the Hibernia Bank Corporation and others to restrain the supervisors from proceeding with the construction of a municipal street railway on Geary Street, using the $720,000 specially appropriated for the purpose.

San Jose.—At the last meeting of the directors of the San Jose-Los Gatos Interurban Railroad Company and of the Peninsula Railroad Company J. T. Burke was chosen to fill the vacant directorship, and upon ballot being taken he was unanimously elected to the presidency of both companies. F. E. Chapin was re-elected to the vice-presidency and the directors are W. C. Andrews, A. E. Wilder and Gus Lion.

Mayfield, Cal.—Engineer McPeak is in town with a large force of workmen arranging to immediately commence the laying of steel on the Peninsula Railroad from here to Los Gatos. Considerable equipment is already on the ground and the work will be crowded to completion. Carney Brothers, contractors, have completed their work and have removed their stock, etc., to Niles, where they have a Western Pacific contract.

San Jose.—The San Jose and Santa Clara Railroad Company has broad-gauged its tracks as far as the car barns in East San Jose. At present the cars run to that point. Every other car connects with the narrow-gauge line in East San Jose for Alum Rock Park, which gives this service a 20-minute schedule. The company has a large force of men at work reinforcing the bridges crossing the Los Gatos and Guadalupe Creeks on the Alameda.

Red Bluff.—The Northern Electric Railway Company, which is now directing its energies toward completing a line into Sacramento in time to handle the Irrigation Congress crowds, has just filed deeds for lands secured in this county from the Los Molinas Land Company, by which it promises to be operating its system into Red Bluff, its northern terminal, by July 1, 1908. The road will then extend from Sacramento to Marysville, Chico, Oroville, Hamilton City, Tehama, Corning and Red Bluff, with a branch to Colusa. With connections made at Marysville with the California Midland electric line to Auburn and Grass Valley, and with the Central Traction Company at Sacramento, it will be possible to cover the entire Sacramento Valley and the San Joaquin as far south as Modesto by electric cars.

Los Angeles.—Traffic on most of the main lines of the Huntington Pacific Electric Railway system was tied up recently for an hour, and Manager Joseph McMillan and four motormen and conductors of the company were arrested because of the failure of the company to obey the order of Justice Frederickson directing the corporation to comply with the fender ordinances of the city. McMillan was convicted in the police court for violating the fender ordinances. Later Deputy District Attorney Fleming, with a squad of policemen, appeared at Fifth and Main streets, almost in the heart of the business district, and arrested the motorman and conductor of the first car that appeared without the proper fender. Four successive cars were thus halted and the employees arrested. Traffic was blocked for a long distance. Manager McMillan appeared and also was arrested. All were released upon bail of $100 each, to appear in Justice Rose's court the next day. Traffic on Main Street was resumed after an hour.

WATER WORKS.

Los Angeles.—Bids will soon be advertised for materials needed by the water department for this year. The contemplated improvements will cost $600,000.

Los Angeles.—The Water Board will advertise for iron pipes and for construction of galvanized roofing for the Crystal Springs and Ivanhoe reservoirs.

San Francisco.—Chief Engineer Schussler has notified the Board of Supervisors that a gang of men would be put to work at once to raise the water mains in lower Market Street to the official grade. The work will take about four weeks.

Stockton.—The Stockton Water Company is installing two oil tanks at its plant at the corner of East and Sonora Streets. An additional building is to be built and new machinery installed, which is to increase the pumping capacity of the plant. Four thousand dollars will be expended in improvements.

Las Vegas, N. M.—The County Commissioners have granted to Hans Olson and C. W. Patterson the right of way for an underground pipe line through the town of Caliente for domestic water purposes. They were also granted a franchise for a telephone and power line over the streets of Pioche and Caliente and between those towns. R. C. Taylor was granted a franchise for electric light and telephone systems in Mina.

Los Angeles.—There will be begun within the next few days the construction of a line of tunnels and ditches nine miles in length to connect with the Barrett dam site the Otay watershed, and form a complete chain of reservoirs and dams for a distance of forty miles. The system will be under the control of the Southern California Mountain Water Company. The contract calls for the expenditure of $100,000. The ditch will be four feet deep.

TRANSMISSION.

Ely.—The Nevada-California Power Company is planning for the construction of a power line to Ely, which, it is claimed, will carry 100,000 volts from its power house at Bishop. It expects to expend $15,000,000 in the next ten years.

San Jose.—At the meeting of the Board of Supervisors recently it was ordered that the franchise to erect poles and wires for transmitting electricity petitioned for by J. A. Belloli be offered for sale. Bids will be received up to September 16th.

Kingman, Arizona.—C. E. Dutcher, a prominent Los Angeles electrician, is in Kingman conferring with other members of the Desert Power and Water Company, regarding the building of the big power plant. Work is now under way on the plant, but supplies are coming in slowly.

Downieville.—Richard Phelan, who is promoting the construction of a big power plant at Denton on the Feather River, announces that before the project reaches its consummation a new railroad connecting Marysville and Oakland, through the Yuba Pass, may result. Phelan states that a 10-foot dam is to be constructed at the mouth of God Lake and the water piped down Gray Eagle Creek to the power plant. It is claimed that 20,000 horsepower can be generated in this manner.

San Francisco.—General Manager E. E. Calvin of the Southern Pacific says that the plans for the power house which is to be built at Fruitvale near the estuary have been completed. It was at first intended to place this plant near the Alameda Mole, but the engineers of the Southern Pacific were unable to find a strong foundation there. It will take a long time to build the power house and the general manager is not able to set a date when the lines to Fourteenth Street, Park Street and High Street will be running by electricity.

Dunsmuir.—The Southern Pacific Company recently laid claim to the use of 5000 inches of the waters of the Sacramento River in the canyon above Dunsmuir. Nothing was given out at the time regarding the use to which the water was to be put, but it is now learned that the purpose of the company is to use the water for developing power in an electrical plant. A plant of considerable magnitude will be built at once, the primary object being to supply the necessary energy to operate the electrical block-signal system between Redding and Ashland. Sufficient electricity will be generated to supply the railroad shops at this point with power and light, and it is thought that electric motors may also be utilized to assist in moving freight trains over the division in the not-distant future.

TELEPHONE AND TELEGRAPH.

San Francisco.—Shuyiro Urata, an engineer connected with the department of industries in Japan, is here from the East, completing a tour of the world undertaken under orders from the Mikado, to inspect the telegraph systems of all countries. He says the United States has the best telegraph service of all he has inspected, that messages are transmitted quicker, that a much larger business is transacted, and that the American operator has his fellow craftsman of other countries beaten for speed and accuracy. But in one particular Urata believes his country excels in the telegraph business—the entire equipment is owned by the government.

Kingman, Ariz.—Work has been commenced on the Mulligan-Thompson Building, which will be occupied by the Postal Telegraph Company. A power plant will be installed.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Henshaw, Bulkley & Co.
Hunt, Mirk & Co.

Alternators
Allis-Chalmers Co.
California Electrical Works

Aluminum Electrical Conductors
Pierson Roeding & Co.

Annunciators
California Electrical Works.
Century-Klein Electric Co.
Holtzer-Cabot Elec. Co.
Patrick, Carter & Wilkins Co.
Tel. and Elec. Equipment Co.

Asbestos Products
Johns-Manville Co., H. W.

Batteries, Primary
California Electrical Works
Gould Storage Battery Co.
Standard Electrical Works

Batteries, Storage
Western Electric Co.
Century-Klein Electric Co.
Gould Storage Battery Co.
Electric Storage Battery Co.
Tel and Elec. Equipment Co.

Boilers
Henshaw, Bulkley & Co.
Moore, C. C. & Co., Inc.
Risdon Iron Works
Standard Electric Works
Tracy Engineering Co.
Hunt, Mirk & Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
Northern Electrical Mfg. Co.

Building Material
Johns-Manville Co., H. W.

Building Paper
Johns-Manville Co., H. W.

Circuit Breakers
Fort Wayne Electric Works
Century-Klein Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Rix Comp Air & Mach. Co.
C. H. Wheeler Mfg. Co.

Conduits
American Circular Loom Co.
American Conduit & Mfg. Co.
Tel. and Elec. Equipment Co.
Century-Klein Electric Co.

Conduit Fixtures
American Conduit & Mfg. Co.
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
C. H. Wheeler Mfg. Co.

Cross Arms
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.
California Pole & Piling Co.

Dynamos and Motors
Allis-Chalmers Co.
Brooks-Follis Elec. Corp.
California Electrical Works
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.
Tel. and Elec. Equipment Co.

Electric Heating Devices
Johns-Manville Co., H. W.

Electrical Instruments
Cutter Co., The
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
California Electrical Works
Northern Electrical Mfg. Co.
Standard Electrical Works
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
California Electrical Works
Century-Klein Electric Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore, Chas. C. Co., Inc.

Electric Watchman's Clocks
Tel. and Elec. Equipment Co.

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.
Standard Elec. Works
Tracy Engineering Co.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engines, Gas and Gasoline
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Byllesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Hunt, Mirk & Co.
Century-Klein Co.
Copeland, Clem A.
Doble Co., Abner
Doble, Robert McF.
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W. E.
Smith, Emery & Co.